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A description of the American Marine Rail-way, as constructed at New York, By Mr. John Thomas, *Naval Architect. With explanations of its principle, and manifestations of its safety for ships of war. By* John L. Sullivan, *Civil Engineer.* [With two copperplates.]

To the Frankin Institute of the State of Pennsylvania.

Gentlemen,

The Marine Rail-way has become a subject of interest to the public, both as regards national, and private economy. Public opinion, which your institution is calculated to enlighten on subjects of mechanical philosophy, being founded in experience, as well as principle, in testimony, as well as practice, it cannot but be satisfactory when one peculiarly qualified to bear witness, is brought thus before those who are so competent to judge.

The inventor of the *American marine rail-way** has not only the advantage of being a practical mechanic, but was brought up in the best school of practice, the naval dock yards of Plymouth, in England, where he served also twenty years, as master shipwright; and perhaps no other man in our country, has had an equal opportunity of forming a correct opinion on the comparative advantages of the marine railway, and the dry dock.

In thus inviting your strict investigation of his improvement as arbiters between him and the American *commercial* interest, he comes before you with the uncommon advantage of not offering a mere project, however ingenious, but of showing you a machine, greatly useful, reduced to practice, operating with perfect success, and producing ample profits.

* Called in the patent, *the Rail-way Dock.*

In a *national* relation, it may be equally useful; because from Long Island to Pensacola the soil is alluvial, and it may be of consequence in public economy, to find an unexceptionable substitute for the dry dock.

If the old custom of heaving ships down, be detrimental to our mercantile marine, built comparatively strong, how much more so must it not be to ships of war, containing at least, eight hundred joints, not one of which, can safely bear to be strained.

The object of the rail-way dock, is to take the ship, as by surprise, while afloat, and before she loses the support of the water, to surround her with other supports, give her keel a firm foundation, her bilge a cradle, and her bends a general and substantial shoring. Without the least change of figure from that she had in the water, she is taken out of it, and being put in complete order, is gently returned to her element.

If it were a question of comparative actual expense, between hauling up a frigate for a *medium repair*, requiring 90 days, or to place her for the same purpose, in a dry dock, Mr. Thomas thinks, from his experience, that the following would be a fair calculation.

To haul up the frigate on the rail-way, - - - - -	$15
To let her down, - - - - - - - - - - - -	3
	$18
To place a frigate in a dry dock, - - - - - - -	$845
To undock her, - - - - - - - - - - - - - -	17
Labour, hoisting up and lowering down, old and new materials, 10 men, 90 days, at 1 dollar per day,	900
Pumping dock 3 times a week, at 16 dollars, - -	208
Loss of time for want of light in dry dock, morning and evening, - - - - - - - - - - - -	100
	$1270

Saving each time, or in this ratio, $1252.

Besides this, the work is best done in the light and air, and an additional value is thus conferred on the whole ship.

A marine rail-way, is indeed of easy device and construction where the tide retires far enough to lay it down on the dry bottom, and where, as in Scotland, the object of it is to receive small, or flat ships, but it is far different, when sharp and large ships are to be safely received, and the greater part of the work is to be done under water. This is the case in all our ports in the middle and southern States, and such is the description of the American mercantile marine. Even many of our coasters, are ships of three hundred tons.

An account of the origin of the first rail-way dock in our country, may be the most suitable *preface* to its description; and the public, may yet owe much to the discernment and enterprise of a few of the

largest ship owners at New York. These gentlemen* knowing the disadvantage to themselves, and others, of heaving down ships, associated to apply for an act of incorporation to build a dry dock, rather than continue that practice. But as it was known to be a very difficult structure, especially as the rise of tide is there but five feet, and a coffre dam would be necessary, it required a large capital to undertake it; and so incalculable was the expense, as to need the encouragement and protection of an annexed privilege of so much value as to balance any possible loss. The Legislature, composed of agriculturists, and of commercial men, were not slow to perceive the advantages of this public accommodation, nor the equity of guarding it, as proposed.

The difficulty, as well as expense, of constructing a coffre dam, and a recollection of Morton's marine rail-way in Scotland, had led Professor Renwick, of Columbia College, who had been consulted as a civil engineer, to advise the company to substitute that invention for the dry dock.

Knowing only that the company was deliberating on the best means of effectuating the purpose of their charter, I wrote to recommend Thomas's rail-way dock to their attention, and subsequently explained its principal features, personally. Upon the representations made to them, the board of directors came to the resolution of building one; and immediately employed Mr. Thomas to construct a diving bell, and to make other preparations. But some of the proprietors were not fully satisfied, and a gentleman, going to England, was commissioned to visit Scotland, to see Morton's invention, and to collect more minute information upon the subject.

On his report, the board again submitted the subject to the judgment of Mr. Renwick, and as the decision of a person so highly qualified, will be a valuable testimonial before the Institute and the public, especially as its candour bears honourable testimony to the integrity with which he executed his trust, I shall presume to offer a quotation from his letter to the Board of Directors, dated the 10th of December, 1825. At page 9, of its printed copy, he says,

"A vessel even of the largest size will be much more free from risk of injury upon a rail-way, than in a dry dock. On the first, she may be completely shored and supported, before her original water borne state is changed; in the last, the application of shores is a difficult and hazardous operation. This advantage, which is in some measure possessed by all rail-ways, is much increased in that erecting for the company, by the improvements that Mr. Thomas has introduced in the *form and structure of the carriage.*

"And here I would state, that I entered upon the examination of that part of the subject, with strong impressions against any alteration from the original plan of Morton, so much so, that I did not hesitate to condemn the works already constructed, merely in consequence of this deviation. In his inclined plane, the vessels are supported upon the

* T. H. Smith, F. Thompson and others.

carriage, by wedges, and this method has been found sufficient for the vessels, of that part of the world. These vessels, as I am well aware from personal examination, are very different in mould from our merchant ships, and still more different from our ships of war, and fast sailing craft. But even in the full built, and flat floored ships of the northern parts of Great Britain, it is evident that the process of relaunching cannot be performed, until all the wedges and shores aft of the midship frame shall have been removed; and in sharp vessels, both the aftermost and foremost sets of wedges will be found difficult of application, and to add little to the security of the vessel. Wedges also appear to be ill fitted to allow of the change of figure that takes place in all large vessels, when they pass from the state of floatation in water to that of resting upon their keels. Impressed with these difficulties, Mr. Thomas has proposed and prepared to carry into effect, such a modification of the rail-way carriage as shall permit the vessel to be supported by stays and shores, as when upon the stocks, instead of resting upon wedges; in this change, I, after mature deliberation, fully concur with him."

While thus adducing such valuable testimonials as are calculated to satisfy the public, (if the Institute should so far approbate the improvement, as to make their Journal its medium to the public eye) I should do the subject injustice, were I to omit to mention the good opinion, also, of the merchants of Philadelphia, decidedly, and unanimously, expressed by a committee of the chamber of commerce, whose attention was drawn, as it passed through the city, to a model of the rail-way dock, ordered by the honourable the Secretary of the Navy, to be made for the use of the department.

On this occasion I ought not to omit the experimental confirmation of the judgment of Mr. Renwick, soon after his opinion was pronounced. I allude to the fatal accident of the ship Panther, which fell over, and was wrecked, at Salem, on a Morton's rail-way. The wedges, being drawn under her bottom upon the cross timbers, could have no other support than those timbers; and should only one, two, or three of them, along midships, have taken the weight, and yielded, however little, the inclining pressure of the ship at the same time must be augmented by the leverage of all that part thereof, overhanging the wedges, which are thus converted to *fulcra*, and the superincumbent weight, to an active force. The danger that the cross timbers will break down, or the ship break in, and thus fall over, becomes imminent, and this accident actually happened, as above stated.

Of the construction and advantages of Thomas's Rail-way dock.

The process of constructing the rail-way dock requires, first, the regulation of the bottom, if so shoal as to interfere with the intended slope of the work; or it may be excavated within the shore, with the proper slope, if a channel should prevent its extension.

The foundation piles are to be driven in four lines; the two inner rows, near to each other, in order to support the keel, the two outer rows, to come under the shores.

The distance between the piles, will be determined by the size of the timbers which bear the iron rails.

The size of the timber, will depend on the burthen of the largest ship which it is contemplated to haul up. Four feet apart, in the centre line, will be generally sufficient; in the side lines, eight feet.

Buffon's experiments appear to be the foundation of the practical rule for computing the transverse strength of timber; which rule is, after much elucidation, given by Dr. Robison, in his System of Mechanical Philosophy, vol. I. According to this rule, an oak stick, 1 foot square, propt every 4 feet, will bear, before breaking, 113 tons, and will not bend with 37 tons.

The piles to be cut off under water, must be cut in the exact inclination of the plane, and level with each other, transversely. The necessity of previously marking every pile separately, on every side, in accordance with the intended inclination of the ways, led to the invention of instruments requisite to the occasion.

An aerial inclined plane, parallel to that intended to be established under water, is obtained by first fixing a true level across the head of the rail-way, and denoting each station by a target, the staff of which is as much above the line of plane, as will bring the lower end of the aerial plane, above water. Targets, having each a staff of the same length, being next applied and nailed to the outer, and some few to intermediate piles, will exactly indicate the aerial inclined plane, while the point of the staff attached to the pile, will indicate a point on one side thereof, in the intended plane of the foundation.

The level and bevel, is an instrument, by which to ascertain every other point on the sides of the pile, that will be in the intended plane. (Fig. 6, e.)

The diving bell may now be supposed to be brought over the pile, and as much of this as it will take in, cut off, together with the target staff, still leaving its lower end. This cutting is repeated till the workmen arrive in the bell, to the bottom of the staff, which remains a little below the last rough cutting. The level and bevel is then set on; this consists of a *base board* with a post arising from its centre to support a plumb line, playing in a comb-piece having a centre notch, to determine when the base is level transversely; and as this base is at the same angle with its post, that the intended plane is, to a perpendicular line, and the base being equally thick, its under side also indicates a parallel plane, so that being secured in its place, the distance is measured by compasses from the *ascertained point* to the base board, and thence to every point in the circumference of the pile, that is also in the intended plane; thus *marking it*, with accuracy for cutting. This operation being the same for each pile, it results that every one must be truly in the intended inclined plane, ready to receive the frames of the rail-way, which are floated over, and sunk down to their places; or a plank is first secured upon the head of the piles, upon which the frames are successively slid down.

The iron rails, will, in point of size, depend on the weight they are to bear. They must of course, spread a sufficient base, to prevent being indented into the wood by a heavy load. The two middle rails,

and the rack piece for the *palls*, are generally cast in one. But if the rails are to be of rolled iron, the rack will be separate. The palls prevent the ship from accidentally running back.

The pressure of the load, will, in the merchant ships, be greater forward and aft, than at midships, because they generally become a little hogged, provision therefore must be made for this contingency, and it will be safe to suppose cases, in which the largest class of ships to be received, will bear all their weight on the first ten feet forward, and the last ten feet aft.

The weight of a ship is often, erroneously, stated to be as many tons as she measures tons. The fact is, that when loaded, she displaces a quantity of water that would precisely weigh her whole weight, cargo included; and as she generally *carries* as many tons as her measurement, she cannot, when light, weigh as many tons as she measures. She weighs only as much as the water she then displaces, and this will be in accordance with her heavy or light materials, oak, pine or cedar. Wherefore, for explanation, I shall suppose the positive weight of ships, to be one-half of their nominal tonnage.

A ship of war will be received upon a rail-way carriage with the precautions to be subsequently explained, and its weight distributed equally over it, and the foundation. The tendency of all ships being to acquire some curvature of keel, it will generally be injudicious to straighten them on the dock, as they will resume their lines on being again put afloat, opening thereby the upper seams, or butts. To keep the ship, when taken out of the water, in precisely the same shape she has in it, the curve of the keel must be ascertained, and the keel blocks be made to conform thereto.

To measure the curvature of the keel, we have devised an instrument, consisting simply of a bar, suspended at each end by a graduated chain. This bar being long enough to reach across the ship, is passed under, and across her centre, at every five or ten feet, when the graduations on the chains will show the difference of depth at every point of contact, from stem to stern. For merchantmen, this precaution will not generally be necessary.

A ship of five hundred tons measurement, will exert a pressure of 250 tons; and we have supposed the whole of this may have to be borne by the two extremities of the carriage, or by ten feet at each end. The axles, therefore, are at the extremities, put *nearest* to each other; but as steam boats will bear heaviest in the middle, the axles must be *near* in the centre also, for their support.

The axles will be two feet apart in the first ten feet. Five axles will have to bear 125 tons, or 25 tons each; the bearings and wheels 12½ tons. The axles of the New York dock, are three inches diameter, and the square of the section is 7.071 inches. The bearings are close to the wheels, in which the axles are *fixed*.

The strength of the rail is deduced from the experiments of Rennie. By a very powerful lever, mounted for this purpose, he proved that a cube of one-fourth of an inch of cast iron, would not be crushed till loaded with 10,000 lbs., a square inch of iron, having sixteen times as much surface, will probably bear 160,000 lbs. or 70 tons. It

is obvious that the wheel will not touch the whole inch, but the adjacent particles will sustain those in contact; and probably the length of the rail, supporting the supposed square on two sides, it will bear more than it would in sixteen separate squares of one-fourth of an inch. A rail of one inch, however, is too narrow to be favourable to the duration of the wheels.

The wheels are considered as columns, as every section under the axle, may be computed in the same manner.

The bearing of the axle, being near the wheel, and the middle being somewhat enlarged, it may be computed to be able to bear in proportion to its diameter; the manner of receiving the pressure being such as not to bend the axle.

The *transverse strength of iron*, does not appear to have been experimentally ascertained on a large scale. Mr. Rennie's trials were on bars propt 2 ft. 8 inches apart. But from the analogy of experiments described in Robison, on other materials, which resulted in showing the transverse strength, when closely supported, to be greater than the strength lengthwise, as 575 is to 205: it will be *safe* to assume it to be double, in this position, to that of suspension. Now as a bar of iron one inch square is estimated to support,

According to Emerson 76,400 lb.
——————— Robison 76,000
——————— Rennie 74,821

The lowest of which is 74,821 lb. (33 tons) it follows that 7,071 inches would support 529,059 lb. and five axles, 1,181 *tons*, calling the two bearings one, because not closely supported on both sides, and instead of assuming the above analogy for position, taking as the rule only the direct strength of the iron.

This excessive strength seems to show that a part of the material might be spared. But in fact, the expense of this ample provision of strength amounts but to a small sum of money. The central axles of the New York Dock, weigh but about one ton, and would together suspend 9,300 tons.

The friction of the axles, should be relieved by the intervention of *brass bearings*, as usual, in machinery; and as Mr. Rennie's experiments proved, that a cube of brass of one-fourth of an inch, would not crush till pressed upon with a weight of 10,300 lb. it is demonstrable that this metal would stand well in this situation

The side axles will sometimes have a proportionate share of the ship's weight to sustain; though she will ordinarily be prevented from inclining to one side, or the other, by the *adjusting screw*, placed at the angles of the shear shores; yet it is necessary to guard against the force of high winds, and the weight which a hogged ship may sometimes throw on to the centre shores, before she is *eased down* at midships by the screws, if intended to be straightened. (Fig. 3. i.)

The carriage is combined in a very strong manner; though it appears to be rather a light structure for its purpose. In its construction, the implement called the dowelling bit, as improved by Mr. Thomas, is of great, and essential, use. (See Fig. 5.)

The dowell, you will recollect, is a cylinder of some hard wood,

(generally lignumvitæ,) which is one half inserted into one, the other half into the other timber where a joint is to be made of their surfaces, which the dowell prevents from moving, or sliding, on each other. To make the *sockets*, for its reception, was heretofore so laborious an operation, that few dowells were used; but they are now applied very easily. The gouge and the screw, perceived on reference to the plate (fig. 5.), are Thomas's improvements. An auger hole, a little smaller than the screw of the bit, being first bored, the thread will cause the bit to advance, as fast as its chisel and gouge can conveniently cut, and thus the whole labour is confined to turning it.

This instrument now makes it easy to dowell the frames of a ship, the knees to the timbers, the water ways to the beams, the thick stuff of the wales to each other, and generally to bind the ship by a solid connection of wood. This instrument, thus improved, has, as I am informed, been adopted into all the navy yards of the United States.

By means of irons and the dowell, the *cross ties* are secured to the cills, in such a manner as to make it impossible that the carriage should spread; and by thus tying the sides to the centre, the cross timbers convert the oblique force of the shores, into vertical pressure; and care is taken, in every instance, *that a wheel shall stand directly under the base of every shore.*

The shear shores (fig. 3.) have a form which gives them great stability in their places, and answers other purposes, to be mentioned; they are based in *hollow coin blocks*, either of wood or iron, divided across the middle of the hollow, by a partition, which serves to hinge the two legs of contiguous shears. There is thus a continuity of *solid material* from the side of the ship to the foundation, from the moment she ceases to float, till she is high and dry.

The shear shore screws, will sometimes have the important office, when ships are old and tender, of taking a good share of the weight of the ship's side, and distributing it along the carriage side, taking it off from the floor timber heads, futtocks, and beam-ends, where ships are most liable to be weak.

The bilge levers, (fig. 3.) are levers of the second class. One end is lodged fixedly on the centre cill of the carriage, while the other end is hove up between the legs of the shear shores, by a windlass placed within them. The moving end is guided in a slot of the prop, and sustained when up to contact with the bilge, by means of an iron pin passing through the cheeks of the prop.

The cradle thus formed by the bilge levers, it is evident, *will fit every successive vessel equally well*, and may be removed, singly, and replaced, as the work progresses. And, as they require to be hauled up with considerable force, nothing can be desired more convenient than these shears.

The common keel blocks are of course placed between the cross ties, and are of such height as to allow ample room for the shipwright to work under the flat of the bottom, standing between, and on the cross timbers. But the bottom of the keel will sometimes have to be repaired; to accomplish this end, the instrument, called the Lifting Plane, has been devised. (Fig. 4.) In the operation of this machine,

two wedges are forced on by percussion; blows from opposite sides being simultaneously given, with the combined strength of a considerable number of men, when the resistance renders it requisite. As I conceive this instrument to be an original invention, and (as it is patented) I deem its description likely to be acceptable in this place: though not a constituent, it is *an auxiliary* of the dock.

The lifting planes are composed of six pieces of timber; and for the navy, may be best made of cast iron, or of wood faced with iron. To make them, let us suppose a block 4 ft. long, and 16 in. square, halved horizontally; and each face of the cut marked lengthwise, and then shaped into two similar planes inclined in opposite directions; the two planes are then divided from each other by a bar of iron, let in edgewise, till its edge is flush with the upper ends of the two planes, in order to guide the wedges. Now let the upper half be placed in its original relation to the under one, (over it,) and there will be space for two wedges, pointing in opposite directions, parallel to each other, separated by the bar of iron before mentioned. The planes being eight, all at the same angle of inclination, the upper block, with whatever may be upon it, will be lifted *perpendicularly*, by driving the wedges. These require heavy blows, and for this purpose, battering rams swung each between two files of men, are necessary. (See Fig. 4. g. g.)

In practice, one of these machines, placed near a keel block, is easily made to take the pressure from it by the least degree of lifting; and thus several machines may be applied, so as even to take away all the common blocks, and they themselves may be readily withdrawn and shifted in position, so as to allow the bottom of the keel to be got at for coppering, shoeing or renewing; and when done, the common blocks are replaced. To do this *when a ship is hove down*, her keel must be hove completely out of water.

The chain, and compound windlass, by which the ship is hauled out, is an expensive and essential part of the machine. The experiments made in England, of late years, may enable me to illustrate the subject of the *resistance* to be overcome on *this* rail way.

The mean result may, it seems, be stated as giving for the requisite power, a horizontal force of the 1-200th of the load, on a *smooth, hard, level* rail way.

This resistance is compounded of the attrition of the rubbing surface of the axle, and the obstacle existing at the rail, to the rolling of the wheel. But however true, theoretically, that the friction must be diminished by large wheels and small axles, yet in the treatises of both Tredgold and Wood, it is admitted to be so inconsiderable, that the principle is established in practice, that the *friction is as the weight*, and that on a smooth, hard rail, *the rolling* motion meets with no calculable obstacle. Friction is proved to be a uniformly retarding force. Velocity does not increase it. Weight alone augments it; and very nearly in its own proportion.

The power to draw up a ship of 500 tons, weighing, as we have assumed, one half the same number of tons, is now to be considered. As the experiments in England ranged from the 1-60th to the 1-300th,

I shall, instead of 1-200th, say 1-100th of her weight is the ratio. To this we have to add the resistance from gravitation in ascending the plane.

The gravitating force of the plane will be to that of the whole gravitating force of the body, falling freely, as the perpendicular height of the plane, is to its length.

The elevation being 1-20, or 25 in 500 feet; if the ship weighs 250 tons, and the carriage 50 tons; (300 × 25 ÷ 500) the gravitating force down the plane is 15 tons. To which must be added the $2\frac{1}{2}$ tons, for the 1-100th of the ship's weight, and $\frac{1}{4}$ ton for the carriage weight, on a level—which 18 tons is 40,320lbs. which the chain must bear: and we have stated, that a bar one inch square, of pure iron, will bear 74,800lbs

The chain of a marine rail-way must be, however, exposed to accidental stress beyond this calculation. It has to ply around a rotch wheel, and animal force is often irregular. A steam engine, whose power can be steadily augmented and controlled, would be the best, when its surplus power can be employed to other labour-saving objects as, for instance, the smithery of the establishment.

The shape of the chain, in order to give it a degree of strength proportionate to the material, is important, as it has to bear the stress of turning around the *rotch* wheel of the windlass.

The windlass is so geared as to adapt it to the power of a few horses: when they travel in a walk, the ship moves up the plane about three feet a minute, and she is completely up in less than two hours. Four horses are a sufficient force for a ship of 500 tons. The horses work in the second story of a small building; they are attached to bars 14 feet in length, proceeding from an upright shaft, on the lower part of which is a bevel wheel communicating with the rest of the gear.

The end of the chain is strongly fastened to the centre of the carriage, with branches passing obliquely to the sides, so that the whole must move equally, and at once.

The reversal of the draught, at will, is an essential provision, in order to draw the carriage out to the extremity of the ways, to which its own gravity would not *certainly* carry it. Because to be able to give the carriage such a position as to afford just water enough for the ship to ground on the upper blocks, is indispensable. To be able to refloat the ship, should she happen, by bad management, to ground otherwise than on the centre of the carriage, may, if on a falling tide, be of great consequence; we must therefore have the readiest means of drawing the carriage down the ways. With this view the chain, after passing the *haul up wheel*, is led to another rotch, with reversed teeth, and thence down along in a trunk, by the centre timber of the ways, till near their extremity; there it turns around a large and strong shiver, and fastens about twenty feet from the end of the carriage, which the chain follows when drawn up, it being supported on rollers. The reversed movement, of course, draws the carriage down, till it touches the stop timber, at the outer end of the railway. The chain is thus disposed of without manual labour. The connection of the second rotch with the first is by intervening gear, so that they move alike.

The ship in descending requires a controlling power, that she may not acquire momentum, and injure the carriage by velocity. The friction for this purpose, is produced by means of an iron wheel, on the upright shaft, placed just below the floor; an iron band is made to clasp this wheel, by the aid of a powerful lever; this is found to be quite sufficient, and very convenient.

The manner of receiving a ship, is this:—She is brought between the wharves of the dock, head on; the carriage is drawn down under her, and perhaps up a little, till her *forefoot* grounds on the forward block; and as ships generally draw more water aft than forward, she is *nearly* aground aft also. The head shores are applied, she is then moved up a few feet, until she is ascertained to touch aft also. The shores are now all applied, and secured, and the bilge levers are hove up to their bearing. She is now ready to rise into the light and air.

I here ask leave to anticipate a mechanical objection to the size of our wheels. *They are small*, because it is an object to keep the carriage *low*, that we may not have to extend the ways farther than is necessary to get the *desired depth* of water on the carriage. I am fully aware that it may be said, that *rollers* would be attended by less friction than wheels. True, but we could not employ them in a submarine movement. They cannot have fixed stations, because they cannot have axles: and if not kept at right angles to the way, they would incline aside. Above water they might be attended.—We must at present, however, content ourselves with our small wheels, according to the local situation, and the size of the ship to be received; waiting until greater ingenuity shall devise a better plan. There will be no difficulty in hauling up any ship on a smooth, hard, and true rail. I only insist that it would be *false economy, to slight* any part of this kind of structure, which is, of course, only accessible, for repairs, by the diving bell—unless, indeed, a frame is to be taken up, for which provision is made while putting them down. In all places exposed to the worms, the timber must be *coppered*, unless the *white gum tree* is found unassailable, as some have represented.

Of the expense, it is sufficient to remark, that every principle being within the rules of mechanical computation, it will not be difficult to make an estimate, when the ground is known, and the prices of materials settled. It will then depend on the size, and other circumstances of the work to be performed.

It may have thus been made to appear to the Institute, that the American Marine Rail-way, is as well adapted to the ports of the United States, as that of Scotland is to the northern ports of Britain. And from the united testimony of experience, and of science, that it is on many accounts, besides that of saving expense, *preferable to the dry dock.* It will give to steam batteries, contemplated in the late report of the Secretary of the Navy, as a branch of harbour and sea coast defence, likely to be increased, a facility of careenage and repairs, almost denied to them in any other method.

While, as an individual, I would not be understood to express the opinion that the dry dock may not be necessary for our ships of the line, yet I think, that it has been made to appear from this statement, that the marine rail-way is convenient, expeditious and economical, for

the smaller class of ships of war. It is peculiarly adapted to alluvial soils, such as the shores of most of our southern harbours. It is, at least, far more economical for our mercantile marine than the old custom of heaving down; and I am happy that complete success in the first example of this machine, in full practice, enables me, to submit it with confidence to your examination.

Respectfully your humble servant,

JOHN L. SULLIVAN.

Philadelphia, January 4th, 1826.

EXPLANATION OF THE PLATES.

PLATE. 1.

Fig. 1. *Ship on the Rail-way.*

a Windlass Loft—*b* Windlass—*c* Chain—*d* Shear shores applied.

Fig. 2. *Stern view of a Ship on the Rail-way.*

a a a The Rail-way—*b b b* Carriage wheels—*c c c* Carriage cills—*d d* Cross ties—*e e* Bilge Levers—*f f* Shear shores—*g g* Scaffold posts.

Fig. 3. *Perspective combination of the Shear Shores and Bilge Levers.*

a The ways—*b* The iron rail—*c c c* The wheels—*d* The cill.—*e* The plank—*f* The cross tie—*g g* The hollow coin blocks—*h* The shear shore—*i* The screw—*k* The windlass—*l l* The bilge levers—*m* The prop.

PLATE 2.

Fig. 4. *The Lifting Planes.*

a The keel of the ship—*b* The upper block of the lifting planes—*c* The under block, do.—*d d* The wedges—*e, f* The block in different points of view—*g g* The battering rams.

Fig. 5. *The Improved Dowelling Bit.*

a The chisel, *b* The cutter, } old implement.

c The gouge, *d* The screw, } improved implement.

Fig. 6. *The under-water Implements, and Works.*

a a a a Piles—*b* Pile standing out of water—*c c* Piles cut off to the line of the plane—*d* Pile in the process of cutting off in the Diving Bell—*e* The level and bevel in the Diving Bell—*f* The batten and target—*g g* The æriel plane, parallel to the intended Plane—*h* The surface of the water—*i* Compasses—*k* The ground—*l* The intended Plane.

Fig. 7.

a The New York Chain—*b* Tucker's Improved chain.

Pl. I. Thomas's Railway Frank.n Jour.l

Fig. 1.

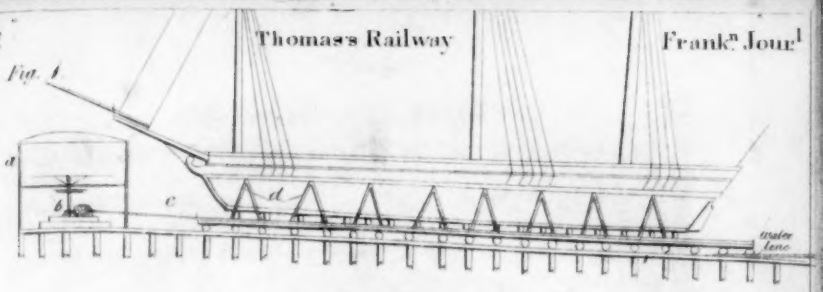


Fig. 2.

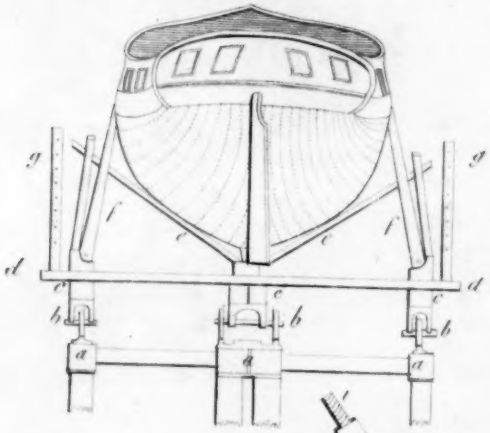
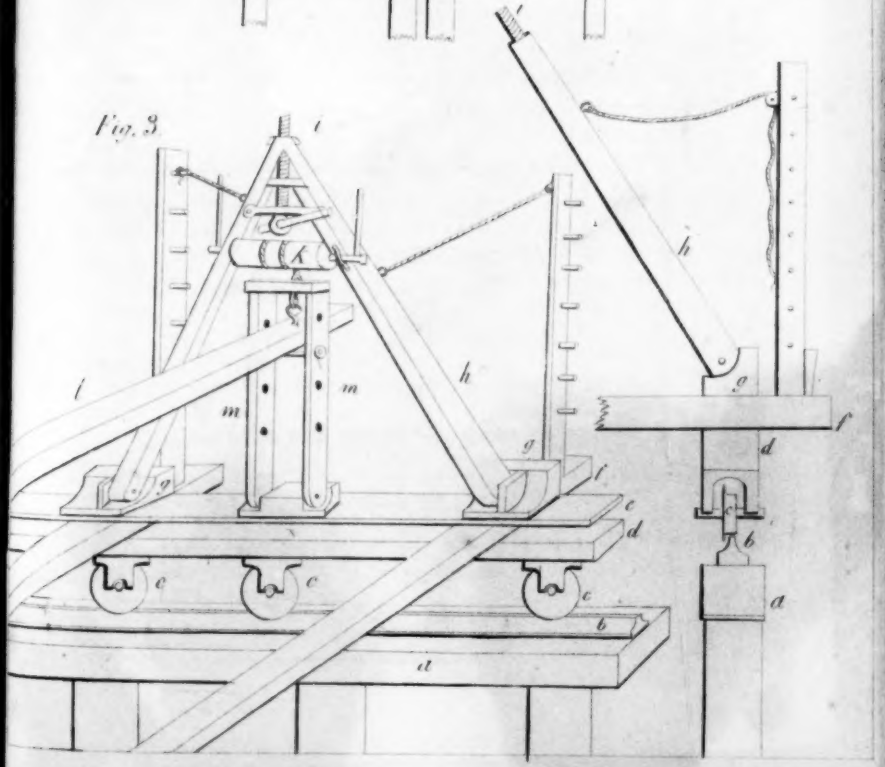
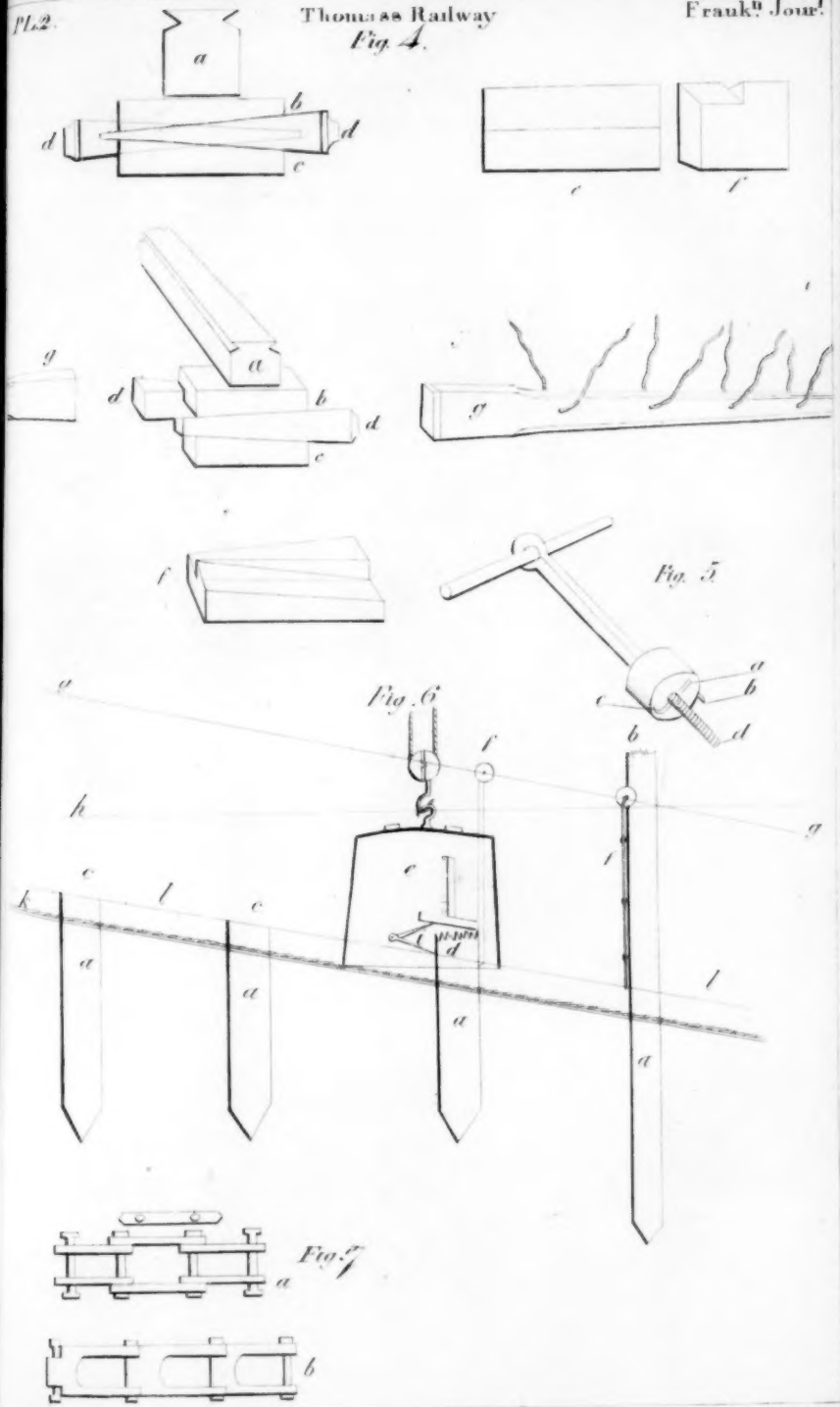


Fig. 3.



Thomas's Railway

Fig. 4.



Addendæ.

An approximation to an estimate of the cost of a rail-way dock, at Philadelphia, for ships of 500 tons, and under.

The Implements (expedient to be preserved) viz: the diving bell, pile driver and their scow, cost at New York,	$3,300
Various tools,	700
The Foundation Piles, the number and length of them will depend on the nature of the ground. Assuming that the number will be 300, and the materials and fixing at $3 each, is	900
Frames to bear the iron rails, and connect all together 7,600 at 30 cents,	2,280
The Capstan House, two stories high,	600
Iron Work, consisting of the rails, rack, saddle-pieces, axles, wheels, gear of the windlass, shafts, plummer boxes, levers, bolts and fastenings of every kind, according to experience in New York,	12,500
The Chain is of a peculiar construction, 300 feet will weigh 20,400 lbs. at 20 cents,	4,000
Labour, driving the piles, and carpenters' work, estimated at	3,500
Land, and Wharves, will probably cost about	10,000
Supervision,	1,000
	$38,780

If the same establishment should have a second rail-way, of dimensions suitable for ships of 200 tons and under, it may be built for the additional sum of $17,000

The Income from the principal Dock, besides the wharfage, may be estimated as follows; the rates of toll being placed at 25 cents a ton, as established in New York. If then one hundred vessels, averaging 200 tons, be drawn up in a year, it will amount to 5000 dollars. The expense of management must be deducted, but a reasonable income from the investment will still remain. The Dock would, however, be capable of doing more business, should the demand for its use be greater.

List of inventions belonging to Thomas's rail-way dock.

Blocks and wedges for gaining access to the bottom of the keel, patented May 17th, 1822. System of shoring, patented February 24th, 1826. Foundation Instruments, and Bilge Levers, patented November 6th, 1826. Authenticated specifications of the shear shore screw, and of the reversed movement, entered August 12th, 1826. An improvement in the rail way dock brake, May 7th, 1826; and in the lifting blocks, May 16th, 1826; for which patents are intended to be taken out, at maturity.

FRANKLIN INSTITUTE.

Report of the Committee of Inventions, on the American Marine Rail-way, constructed by Mr. John Thomas of New York.

The Committee of Inventions, to whom has been presented for examination, by John L. Sullivan, Esq. of New York, Civil Engineer, a description, with drawings, of a Marine Rail-way, exhibiting the improvements made by Mr. John Thomas, of New York, Ship builder,

Report—That they are fully satisfied, that the improvements made by Mr. Thomas add greatly to the security of a vessel when drawn up on Marine rail-ways, for the purpose of being repaired; and obviate most of the difficulties which have attended the hauling up, on ways heretofore constructed. The shear-shores possess a degree of stability, which gives them a decided advantage over those of the ordinary form, and the facility with which they may be applied and adjusted, appears to the committee a point of great practical importance. The support derived from the bilge-levers, is well calculated to prevent that injurious strain to which a large vessel is liable when removed out of the water, without having her bilge supported; these levers form a cradle, which admirably adapts itself to the shape of every vessel; whilst the facility with which these levers, and the shear-shores, may be successively removed, for the purpose of coppering, or of making other repairs, add much to their utility.

The committee do not enter into any particular detail upon this subject, as the description and drawings which accompany this Report, render such a detail unnecessary. The excellence of the structure is not a point of mere speculation, as a rail-way upon this plan has been in operation in New York, for several months, and, it is believed, has completely fulfilled the expectations of the proprietors. A great number of vessels, of different sizes, have been drawn up, repaired and relaunched, with perfect ease and safety. This rail-way was constructed under the direction of Mr. Thomas, and although it was the first trial of his improvements, his practical knowledge has been strikingly evinced, in the firmness of those parts of the structure, upon which the greatest strain falls, whilst the carriage is not loaded with a weight of materials, which does not add to its strength.

The superiority of *rail-ways*, to dry docks, in several points of view, is acknowledged by all who are conversant with the subject. The dry dock is by far the most expensive in its construction, whilst humidity, darkness, and want of room, interfere materially in carrying on the requisite operations, after a ship has been secured in it for repair. To obviate these objections by increasing the size of the dock, would, in most instances, add so greatly to the expense of building, and of using it, as to prevent, on the part of the mercantile community, every attempt to establish them.

ROBERT M. PATTERSON, *Chairman.*
THOMAS P. JONES, *Secretary.*
Philadelphia, January 10th, 1827.

FOR THE FRANKLIN JOURNAL.

Observations on the Floating Dock, invented by COMMODORE BARRON; *as described in the Franklin Journal for January*, 1827, *and recommended by a Select Committee, to the Merchants of Philadelphia.*

THE Journal of the Franklin Institute, being a free and open channel of information to the public, on all scientific subjects, and more particularly upon practical mechanics, the remarks to be now made on the Floating Dock, will, I hope, be considered as springing from a desire to promote its views. The publication of descriptions of machinery, for new and useful purposes, is intended to enable the public to appreciate them justly, by an accurate knowledge of their principles of construction and operation, and therefore of their cost, economy, and comparative utility. A frank and strict investigation of their claims, must consequently promote the objects of the Institute; nor will an expression of adverse opinions, be construed into disrespect to a committee of its appointment.

The personal, and professional, respectability of the committee, composed, as it was, of men esteemed able, as well as willing to investigate, and judge of an invention known by them to be a desideratum in our sea ports, would forbid a mere practical man from expressing the reasons of his doubts, whether they have not underrated the mechanical difficulties, as well as the cost, did not their individual characters, as well as the commodore's own elevation of mind, authorize the confidence, that they are open to conviction, if in error; or if they have been too much warmed by friendship, and an enthusiastic admiration of genius, that they will again deliberately, and calmly, consider the subject.

It is certainly very much to be regretted that Major Wilson, one of the committee, was not here when the report was finally made up, as he, probably, would have superadded, in his usual accurate manner, the dimensions, the quantity of materials, and an estimate in detail, of the cost; because *he* is well aware, from a long and highly respectable professional career, that the opinions of even the most eminent engineers are rendered valuable, solely by the confidence felt, that they are *ready to be demonstrated;* while, on the contrary, it is a tribute of respect, which the world pays to those engaged in other arts and professions, that their opinions are *implicitly received*, because the public *cannot* readily understand the grounds of them.

That in all the mechanic arts, there must be an adequate adaptation of the means to the end, is obvious. Our reflections on the *floating dock*, have not led to the conclusion that it is an impracticable project, but, with all the ingenuity displayed, a *very difficult one*. And perhaps the consideration of what appear to be the difficulties, will, if well founded, only prompt so able a mechanician as Commodore Barron, to devise some easy remedy for them.

Owing, it may be presumed, to the absence of *one* of the committee, as before mentioned, the report refers to the engravings illustrative thereof, for the relative proportions of the dock, and ship: and it is stated, that for a dock capable of receiving a ship of 300 tons, the ex-

pense need not exceed 4,400 dollars. Fig. 1. represents such a ship, in such a dock: the dock then must be larger than the ship. Judging from their proportion to each other in fig. 1—the chamber of the dock is two-ninths wider than the ship. A ship of 300 tons, may be 27 feet; the dock will then be 33 feet; the trunks each 4 feet; the depth of the dock must be 14 feet; its length 100 feet; its tonnage, carpenter's measure, 500 tons. Is there any reason why this dock should cost *less* than the hull of a ship of the same tonnage? Yes: It has no deck. But it has trunks, "*air tight*" trunks, its whole length; these are to be built on to the side, and must therefore be timbered, kneed, and bolted, as well as planked; and all this, may fairly be supposed, *at least*, to equal the materials and work of the deck of a ship.

But what reasons are there for building a floating dock as strong as a ship? The committee intimate that to guard the bottom against warping, it must be built with peculiar strength; the reasons for which are well known to ship builders, and nautical men. The tendency of all ships is to be become hogged, because the sharpness forward, and the leanness of the bottom aft, do not permit those parts to receive so much support from the water, as it gives at midships. The more frequent caulking of the upperworks than of the bottom, also, gives a fixedness to the curve, which the keel acquires. When such a ship (and all ships are such) enters the floating dock, she grounds, head and stern first; and if strong enough to keep her shape, her whole weight must be divided between her two extremities; unless, indeed, a few of the shores along midships, being applied as soon as, or before the water begins to leave supporting her, take some of the weight of midships. We must then have the weight of the whole ship, on either two, or four spots, in the bottom of the dock; either 75 tons, or 37 tons on each. Is the bottom in no danger of warping? If not, why in the marine rail ways do they so multiply the number of axles under the bow and stern, to receive the pressure above described? Who that observes their operation but will acknowledge the excessive pressure on the head block? Why is the support at the bilge, by levers, so highly thought of? Why is the degree of a ship's hogging sometimes ascertained, and the whole range of blocks on the carriage, made to conform thereto? Practice proves the fact, that this is necessary; and it is a very serious fact, for the floating dock, which, in addition to its want of *solidity*, cannot have its receiving blocks adjusted, without previous pumping out; thus making two pumpings necessary to one ship.

The Report states, that the sides must be very strongly joined to the bottom, with knees well bolted, and that for strength and shape, the dock is to be compared to a scow. There is this difference, however, that it is not nearly so strong, in proportion to its size, from its being open at one end. The angle made by the bottom and side, where the grub seam must be, is in all scows, the most difficult to keep tight; and the more so, the larger the fabric; because the fastenings relied on, are the iron bolts; but as the labour of man is never as effectual on large as on small work, the iron fastenings, there-

fore, in these strong knees, and thick stuff, will not be so embedded, but that they may *work loose;* especially by great stress.

That they are exceedingly exposed to this effect is demonstrable: for we must recollect that the bottom, loaded with ballast, is by them hung to the sides, and by them the whole weight of the ship too, added to this ballast in the bottom, must be sustained: that when the dock is full of water, and the *trunks* immersed by the weight of the ballast, as well as the body of timber of which the bottom is composed, they lift the whole, before the water is pumped out; nor do they lift perpendicularly, but their load is attached to the sides of the trunks; this tends to press the side of the dock inwards. When the ship is in, those of her shores which are diagonally placed, rest against the bottom; those placed horizontally, press the side outwards; at the same time the trunks, which, considering their office, cannot be very light, hang their weight on the outsides, co-operating with the shores to bend the sides outwards. Now these several forces, operating successively in different directions, outwards and inwards, upwards and downwards, pressing and relaxing, act upon those bolts, and tend to loosen them in the wood, and must gradually, if not quickly, produce this effect; an effect that must put an end to the tightness and usefulness of the dock. From these considerations, it is fair to conclude, that as the dock must be at least as strong as a vessel, it cannot cost less, per ton.

There are some minute practical considerations in the aggregate worth mentioning, which tend to confirm this conclusion: and should these reflections meet the eye of the engineers of the committee, they may be reminded of the difficulty of keeping canal gates tight; that sometimes floating substances will get between them, and greatly increase the loss of water. This may be of no great importance there, because it is a leak outwards; but the case is very much altered when it is inwards, and that into no very large space, and under the pressure of a head of ten feet of water.

Again:—What skill is not exerted by the profession, in building the most *substantial foundations and side supports, of the Gates of the Dry Dock!* No engineer can say, that it is possible to give the Floating Dock an equally substantial and perfect gate: and yet a Dry Dock presenting only a narrow front to the tide, and not having a bottom, and sides, full of seams, is, necessarily, pumped frequently, when a ship is under repair within it. But the most formidable cause of strain, and liability to get out of order, still remains to be mentioned. *It is the action of the ship.* She is, if possible, placed precisely in the centre; but, could a perfect equipoise be produced, it could not be maintained; it would be destroyed by the lightest breeze; the weight will unavoidably be greater on one side of the centre, than on the other; she will consequently tend to incline, as soon as she begins to lose the support of the water. It was this water that constituted her *stability.* She now begins, through the medium of her shores, to lean on one side of the dock: but the dock is nearly full of water, and can have no stability, unless it be derived from the ballast, and the trunks; it is on these, therefore,

that the inventor relies. But let us examine the operation a step further. The ship inclines, one trunk is depressed, the other rises; one resists the leaning of the ship, the other assists it. We may admit that the depressed side is not yet under water: but the more the dock is pumped out, and the more its consequent buoyancy increases, the more the ship will incline, not only by its whole weight, but by the *leverage* of the upper works, and of every thing aloft, in proportion to their distance from the head of the shores, which act *as fulcra;* and the more she leans, the more stress have the horizontal shores to bear. The question now is, whether the depressed *air tight trunk* will, by its buoyancy, right the ship, or be immersed by the joint action of the ballast, and the ship upon it. This is a calculation for engineers and nautical men to make, the *data being first known;* the weight of ballast, the weight of ship, the angle of inclination, the leverage power, and its increase, being placed on the one side; and the displacement of water by the *immersed trunk*, on the other; would determine, with some probability of precision, (the wind not blowing,) how large the trunk should be.

It is this, which the recommended experiment, is, we may presume, intended to decide. There was certainly talent enough in the committee to have balanced these forces, and to have computed every possible contingency, without subjecting the merchants to the loss of even "three thousand dollars."

If the action, and reaction, we have described, should cause the floating dock to leak, the committee say, that "the repairs of this structure can be effected with despatch and economy—if the bottom requires inspection, the dock can be hauled up on a common building slip, and examined." With great deference to the committee, I confess, that I more than doubt the *despatch and economy* of this operation. If so easy a thing to do, why are vessels generally *hove down*, under all the disadvantages, and with so much detriment, as the committee justly describes?* In fact, it is a very different thing to launch a ship and haul her back again. *Facilis descensus Averni:—Sed revocare gradum,—Hoc opus hic labor est.*

I am aware of the difference in the form of the bottom, but whether flat or curved, there must be bilge ways applied. To the bottom of a ship, as narrower than the dock, they may be supposed to give a better support. Compared with the width of the dock, the "common building slip," (if by this they mean the launching ways,) is very narrow. If, however, by it is meant the slope of ground, or place where building is done, then the preparations for the supposed operation, cannot be very economical. Besides, if the cables, or chains, are made fast to the dock itself, it will be a question whether the dock will be hauled up, or pulled to pieces.

From attentively considering the subject, I cannot help coming to the conclusion, that a floating dock of 500 tons, will cost, at least, 25 dollars per ton, which will amount to 12,500 dollars. The pumps, the power, the cables, moorings, &c. we may conjecture, will cost

* See pages 3 and 4 of this volume.

8,000 dollars, and the locality, probably 10,000 dollars. I do not say, that even this is too much, should it answer the purpose, but it is considerably more than the report contemplates.

A SHIPWRIGHT.

Philad. Jan. 20th, 1827.

Specification of certain Improvements on the Balance Lock, or Inclined Plane, intended as a Substitute for Locks on Canals, especially on such Canals as have a great lift, together with a scarcity of water. Invented by MINUS WARD, *Civil Engineer.*

In order, the better to illustrate the utility of the invention, we will first describe the whole machine, and afterwards point out those particular parts which are new and peculiar. The two sections then of the canal, which are upon different levels, are to be brought, the one to the foot, and the other to the top, of that declivity of the ground which may present itself as most favourable for the site of the works. The lower section of the canal terminates at the foot of the declivity in form of a basin of a sufficient area and depth, for the purpose intended. The upper section of the canal, branches off, a small distance above the works, into two branches, which branches terminate in open mouths, constructed with two side walls and a flooring of hewn stone each; they terminate abruptly, at right angles to their length, and are so situated as to stand with their mouths pointing directly towards each other; the upper side walls, of each, or those next the hill, being in the same straight line, and the lower walls of each, are in a like situation with respect to each other. These mouths are but a few inches wider than the width of one of the boats intended to be navigated upon the canal, and of a depth no greater than is sufficient to float a boat, when loaded. The distance between these two mouths, exceeds, by a few inches, the aggregate length, of the two moveable receptacles, in which the boats are contained during their ascent and descent; which receptacles, we will call the *cradles*, and of which, a more particular description will be given further on. But to return to the mouths belonging to the upper canal; each of these mouths is furnished with a *sliding mouth piece*, constructed of sheet iron, one-fourth of an inch in thickness, rivetted together in the manner of steam engine boilers, with their bottoms horizontal, and sides vertical, with both their ends open, excepting when those towards each other are occasionally closed with gates; these mouth pieces we will hereafter call the *connectors:* they lack two inches on each side, of being as wide as the stone mouths, in which they work; they need not exceed three feet in length each, in the direction parallel to the walls, and to their own motion; they are supported at the ends towards each other, by a ledge of wood, extending across, and being made fast to the bottom of the stone mouth; two other pieces extend up, one on each side, to the top of the walls, so

as to fill the space between the outsides of the connector, and the insides of the stone mouths. In like manner the other ends are supported by similar ledges of wood, except that each is furnished with two of those ledges, placed three inches apart; the three inch groove thus formed between the ledges, is filled with oiled hemp, so that the sliding mouth piece can move backward and forward upon the hemp, in a direction parallel with the walls, and yet no water can pass between the sliding mouth pieces, and the stationary stone mouths. Each of these connectors is furnished with a pair of gates, also of sheet iron, hung upon the ends of the connectors towards each other, by hinges on each side, and meeting together in a straight line when closed in the centre of the breadth of the sliding-mouth-piece, each pair of gates, opening into the cavity between the walls; their bottoms resting against a flaunch of three inches in breadth, formed by turning in the edge of the connector; they rest also at their sides, against similar flaunches, up the sides. The tops of these gates, in order to save room, are furnished with a bar, or brace of iron, extending across the top of the gates, nearly to the hinge side of each; this brace is supported, however, by only one horizontal screw bolt, in the wing of one of the gates, so that it can be turned up in a vertical position, at the time of opening and shutting the gates. These connectors have each a rack, made fast to the under side of their bottoms, with a shaft extending across, under each, and a pinion made fast to each shaft, working into the racks. Those shafts project out on the upper side, beyond the outsides of the walls, with a ratchet wheel, six feet diameter on the outer end of each shaft, and a click to hold both ways, so that with regard to this ratchet wheel, its shaft, pinion, and the rack in which it works, as also the motion, or effect produced, is precisely the same, as it is in the well known contrivance, for the carriage of a saw-mill, except that the clicks are made to hold in either direction, as the case may require. The ends of these connectors toward each other, extend a few inches beyond the terminations or ends of the stone mouths. We have already stated, that each connector is furnished with a flaunch, for the gates to shut against, but those flaunches, serve another, and a very remarkable purpose, and upon which, the facility and despatch of passing a boat, in a great measure depend. The faces of these flaunches, toward each other, are armed with about a dozen thicknesses of canvass.

The two cradles are constructed also of thick sheet iron, each of a capacity sufficient to contain the boat; each of them is furnished with a separate chamber under its bottom, of a capacity to hold a quantity of water sufficient, so that when one of the cradles has this inferior chamber filled with water, and the other cradle, at the same time, having its inferior chamber empty, a preponderating force is obtained sufficient to give the requisite velocity to the cradles. These cradles are mounted upon cast iron wheels, and move up and down, side foremost, upon cast iron rail-ways, placed in an inclined position, to suit the inclination of the ground, not being confined to any particular inclination or height. The cradles are so situated, as to pass each other, leaving a few inches between their ends, at the time of passing.

Their ends towards each other, are closed, the other ends are furnished each with flaunches, and a pair of gates, exactly similar to those already described. The gates open into the cavity of the cradles. The bottoms of the inferior chambers are constructed so as to incline to the horizon in an angle nearly equal to the angle of the rails, and in the same direction, forming an acute angle with the lower side of the cradles; this will cause the cradles to enter the water in manner of a wedge, causing little or no collision. A strong frame work of timber covered with a shed, is placed upon the brow of the declivity, at the upper end of the rail-ways, in which are supported six drums of cast iron, furnished with fly wheels of the same metal; from three of these drums, a like number of chains extend to the ends, and middle, of one of the cradles; and from the other three drums, chains extend in like manner, to the other cradle; connecting chains extend also, from one set of drums to the other, so that one cradle cannot descend without causing the other to ascend; or, perhaps, instead of placing the drums vertical, and using connecting chains, a better modification would be, to place all the drums on one horizontal shaft, extending the whole length, across the top of the rails; this shaft should be cast hollow, of a diameter and thickness of metal sufficient to ensure it from twisting off, with a gudgeon at each end, and supported in a sufficient number of places along the shaft, by resting on the circumferences of other wheels, generally termed friction wheels; the chain from one cradle, to one set of drums, wind on to the drums by the under side, and those from the other cradle, wind on by the upper side of the other set of drums, with but one fly wheel in the middle of the shaft. These chains are of such a length, that when one cradle is in a line with its corresponding connector, the other is immersed in the water of the basin below, so that its upper edge shall be level with the surface of the water. The inclined railways extend down into the basin deeper than the cradles are intended to descend, and there are six of them, three for each cradle. The fly wheels are furnished with brakes: these consist of a strap of iron extending round the wheel, for about three-fourths of its circumference, and furnished at one end with a lever, to give the necessary purchase; the other end is made fast to a stationary stud. When the lever is pressed upon with the hand, the strap binds hard upon the extreme surface of the fly wheel, thereby causing great friction, at other times it does not touch the wheel. Each cradle is furnished with a strong pall, in the middle of its length, to stop it in a line with the connector, while the boats are floated in and out, the brakes are also drawn at the same time hard down upon the fly wheels, and hooked, and assist very much in holding the cradles. The operation is as follows. Suppose one of the cradles, to be held by its pall, assisted by the brakes; the keeper goes to the ratchet wheel of the connector, corresponding to this cradle, throws out the click, which holds the connector back, and applies his foot upon the pins, in the side of the ratchet wheel, for that purpose, and turns it round; this forces out the connector, and brings its armed flaunch directly in contact with the corresponding flaunch upon the cradle,

and presses them together with sufficient force to make the joining water tight, when they are held in this position by the click; then by drawing a small wicket gate, in one of the gates belonging to the connector, the water of the upper section rushes in and instantly fills the small space between the two pair of gates, when these last may be opened with ease, for the pressure is now equal on every side. A boat wishing to descend, may now pass directly into this cradle, for it has in this position, become a part, and extension of the upper section of the canal; but as the other cradle is, at this period, immersed up to its top, in the basin below, a boat wishing to ascend may open the gates, (for the pressure is equal on each side of these gates) and pass into this cradle, and close the gates behind her; but before it can ascend, the boatman must draw a gate, which will suffer the water to run out of the inferior chamber of his cradle; this it cannot do, until the cradle is suffered to rise, because the chamber is entirely under water; but by this time, the keeper has closed the two pair of gates above, thrown out the click, which held the connector pressed against the upper cradle, drawn back the connector far enough to clear it from the cradle, say two inches, the small quantity of water which was contained, between the two pair of gates, drops down and runs along a gutter into the basin—then, by first letting go the pall, and next unhooking the lever of the brakes, this cradle (having had its inferior chamber filled with water, previous to the closing of the gates, by drawing a horizontal valve in the bottom of the superior chamber of the cradle,) will preponderate, and raise the other, so as to bring the surface of the water in its inferior chamber, above the surface of the water in the basin, when the water contained in the chamber commences, and continues to run out, as the cradle rises, until it is all discharged; the other cradle is suffered to come down with an accelerated motion, the velocity of which descent must be so regulated, by the quantity of water which has been suffered to run into the inferior chamber, as to cause the fly wheels to perform a peculiar office assigned them, which is this: when the descending cradle has reached the surface of the water in the basin, and its submersion commenced, the buoyancy of the water contained in the basin, gradually takes off, and finally destroys its preponderating force, and an equilibrium will be attained, at a point somewhere between the commencement and the termination of the submersion of the cradle; that is, if the cradles were suffered to come to an equilibrium, the upper cradle would be found, by reason of the buoyancy of the water in the basin acting upon the other cradle, to be something below its corresponding connector.

The requisite accelerated motion spoken of, and the effect to be produced by the vis inertiæ of the fly wheels, is to carry the ascending cradle something higher than the connector, where it is caught by the brakes, and suffered to return gently upon the pall: but it would not return upon the pall with an injurious velocity, if no friction was applied; because the lower cradle having become surrounded with water, can move side foremost through it, with but a slow motion, beginning as it does from a state of rest, and not passing over more than from 12 to 18 inches. The keeper, then, by going through the

same operation with this side of the machine, forms, by means of the ratchet wheel and connector, the connection between this cradle and this branch of the canal; the wicket or small gate is drawn, the two pair of gates are opened, and the boat which has thus ascended, is at liberty to depart on her way, and another ready to descend, may take her place in this cradle, and close the gates behind her, when the communication may be cut off by drawing back the connector, as it was on the other side; in the mean time, the boat which has descended, having now the top of her cradle upon a level with the surface of the water in the basin, is at liberty to open the gates of this cradle, and to depart; another, wishing to ascend, may now take her place, and close the gates behind her. One half of the apparatus, being an exact counterpart of the other, the ascent of this cradle, and the descent of the other, is but a repetition of the process already described, this half of the apparatus performing now, what was before performed by the other, and so on alternately. But, it is evident by this arrangement, that we can, not only thus ascend with one boat, and at the same time descend with another, but that a boat may ascend without the necessity of waiting for another to arrive to descend at the same time; and vice versa; because the superior chambers being always full of water, the entrance of the boat by displacing its own weight of water, causes no addition to the weight of the cradles.

The points of difference between this balance lock, and others which have been proposed, some of which are in operation, appear to be first, and principally, in the facility and despatch, which by means of the sliding-mouth-pieces, we are enabled to form, and to cut off at pleasure, the communication between the cradles and the upper section of the canal; 2d, in the use of the vis inertiæ of the fly wheels, in carrying the cradles beyond the point of equilibrium, thereby avoiding the necessity of a set of mouths at the lower end of the inclined rails like to those above, which would otherwise be necessary. And 3d, in the manner of hanging the gates, and of bracing them across their tops by the revolving bar.

FOR THE FRANKLIN JOURNAL.

A further description of Ward's Balance Lock.

MR. EDITOR,

The accompanying printed description of "The Balance Lock," &c. was written in the year 1824, and published in the Baltimore American, of the 15th. Dec. 1824.

On mature reflection I deem it adviseable to give a general outline of the principal features of the machine; and I also add, a further description of that most essential part of the invention, "*The Connectors.*"

1st. The cradles of this machine move up and down upon the inclined railway, *side foremost*, as proposed by Robert Fulton. [Vide

Repertory of Arts, vol. 7. page 222.]—This enables us to lay the rails with an elevation of about 30 degress to the horizon, which saves a considerable proportion of the expense, by shortening their length, and enables us to give the cradles a much greater velocity; they being allowed to run on, until they stop spontaneously; no solid body being interposed in the line of their motion, which is the case if we attempt to move the cradles end foremost.

2d. The preponderating power is obtained by filling with water, and emptying, as occasion may require, an extra chamber, attached to the cradles, as proposed by Leach, an English Engineer. [Vide Rees's Encyclopædia.]

3d. The ascending cradle is carried above the point of equilibrium, and also above its corresponding mouth of the canal, by means of the vis inertia of a large fly wheel, attached to the horizontal shaft, upon which the chains from the cradles are coiled, without the necessity of introducing cog wheels, which would be expensive, making the machine complicated, and even dangerous. The vis inertia of the fly wheel, causes the machine to overrun the point of equilibrium, and as it returns again, upon the principle of common vibrating bodies, being still urged toward the point of equilibrium, it is arrested at the proper time and place, by the pall. This I claim as my invention, and believe it to be better entitled to the character of "boldness"* than are other plans which have lately been published.

4th. The method of *forming*, and *cutting off*, the communication between the cradles, and their corresponding mouths of the canal above, by means of *sliding connectors*, moving, water tight, through a packing of oiled hemp, I also claim as my invention. This part of the machine, completely removes the difficulty heretofore existing, in forming a water tight connexion between the cradle and the upper section of the canal, a difficulty foreseen by the able committee of the Franklin Institute, who reported on Professor Renwick's inclined plane.

In the description of my inclined plane, published in the Baltimore American, I proposed to use two, or more, chains; this idea, therefore, was not new, when Professor Renwick published his views upon this subject.

5th. The method of hanging the gates, to form a straight line across the cradle, and the method of supporting them by means of the revolving bar at the top, I also claim as my invention.

After further consideration of my *connectors*, I propose to have three racks to each *connector*, with a pinion, shaft, ratchet wheel, and click, to each rack; entirely separate and distinct from each other: viz.—One under the centre of the *connector*, as proposed in my description, dated 1824, and one on each side at the top edge of the *connector*. The rack bar, of the rack below, must be fixed to the bottom of the *connector*, by a single bolt, and allowed to turn freely on said bolt. The *connector* should also be made short, in the direc-

* Vide Report on Professor Renwick's inclined plane, &c.

tion of its motion, say only 12 inches. By this arrangement, if one end of the cradle should gain upon the other end, in winding up, so as to make a difference of an inch or two at the parts of contact, between it and the cradle, when you come to force the *connector* out against the cradle, if one end of the *connector* touch the cradle, first, it is free to turn upon the bolt in the centre, and allow the other side to come up also. The complete contact of the two surfaces, is further facilitated by the two racks above.

A model which I had made in 1824 was seen in operation in this city, by Robert Smith, Esq. former Secretary of State, U. S.; J. L. Sullivan, Civil Engineer; Capt. Poussin, Top. Engineer, U. S.; Lieut. Sherbourn, Hydrographer, U. S. N.

By inserting the above remarks, together with the accompanying printed description, in your useful Journal, you will much oblige,

Yours, &c.

MINUS WARD.

Baltimore, January 11th, 1827.

FRANKLIN INSTITUTE.

At a Meeting of the Franklin Institute, held at their Hall on the 18th day of January, 1827, JAMES RONALDSON, President, in the Chair; THOMAS P. JONES was appointed Secretary.

The Managers presented their twelfth Quarterly Report, which was read and adopted.

The Treasurer presented the third Annual Report of the state of the funds, which was read and adopted.

On motion, Resolved, That the thanks of the Institute be presented to the Treasurer, John Richardson, for the able and faithful manner in which he has performed the duties of his office.

The tellers, who had been appointed by the board of Managers to hold the Annual Election of Officers for the year 1827, reported the following as duly elected.

Officers for the year 1827.

PRESIDENT—James Ronaldson.
VICE-PRESIDENTS—Mathew Carey, Paul Beck.
RECORDING SECRETARY—Thomas P. Jones.
CORRESPONDING SECRETARY—Peter A. Browne.
TREASURER—John Richardson.

MANAGERS.

Thomas Fletcher	Rufus Tyler
John Harrison	James J. Rush
S. V. Merrick	H. J. Riehle
Daniel Groves	Clement C. Biddle
Abraham Miller	John Struthers
Adam Ramage	John O'Neil
Harvey Lewis	Robert E. Griffith

R. M. Patterson
James M'Alpin
Isaac B. Garrigues
William S. Warder
A. G. Ralston
M. W. Baldwin
W. S. Hansell
Joseph H. Schreiner
S. J. Robbins
Joseph Beale

(Adjourned.)

JAMES RONALDSON, *President.*

THOMAS P. JONES, *Secretary.*

Abstract of the Twelfth Quarterly, or Third Annual Report of the Board of Managers.

The Board state that the regular courses of lectures on Mechanics, and on Chemistry, had been resumed, and regularly continued; that Mr. Raffinesque had given several lectures on Natural History, and that volunteer lectures had been occasionally given by others.

The Mathematical school has been abandoned by Mr. Espy, in consequence of the slender encouragement received; but the Drawing school continues to flourish, there having been fifty-five scholars, during the first quarter.

The High School is in complete operation, with its full complement of scholars, 304; of these, 300 study the English Language, 153 the French, 105 the Latin, 35 the Greek, 45 the Spanish, and 20 the German; 300 Elocution, 240 Geography, 231 Linear Drawing, and all, Arithmetic, or some other branch of the Mathematics. The Board state that no public examination having yet been had, they cannot speak definitively respecting its real merits, but think it calculated to do much good, and that it ought to be cherished.

The Board recommend to their successors, to adopt effectual measures for the display of the Models, Minerals and Books, belonging to the Institute; this object having been neglected, in consequence of the appropriation of the third story of the Hall, to the use of the High School.

Many interesting and valuable inventions have been referred to the Committee of Inventions, and several of the reports upon them have been published in the Franklin Journal.

The Hall of the Institute has been completed, and the Building Committee were on the eve of a final settlement with the contractor.

Two hundred and twenty new members have been elected during the year. The Treasurer's Report presented a balance of $743 45 in his hands.

COMMITTEE OF INVENTIONS.

Report on the "Radiating Rail-ways, for the repair of Vessels." Invented by EDWARD CLARK, *Civil Engineer, New York.*

[WITH A PLATE.]

The Committee of Inventions, to whom have been submitted, a Model, Drawings, and Description of the "*Radiating Rail-ways for the repair of Vessels*," invented by EDWARD CLARK, of New York, Civil Engineer, Report, That they have carefully examined the proposed improvement, and consider the plan as offering great facilities, when it is desirable to have several vessels under repair, upon the ways, at the same time. Morton's Patent Slip, which is in use in Scotland, is of sufficient length to contain two or three vessels; but it is evident that whichever was the last hauled up, must be the first launched, and they must, therefore, be frequently repaired in haste, without being allowed that time to dry, which is, in many cases, a point of great importance: to obviate this difficulty, is the end proposed in the plan now under consideration.

It does not appear, from any thing which has been presented to the Committee, that Mr. Clark proposes any thing novel in the construction of the lower part of the rail-way or of the carriage upon which the vessel is to be drawn up; its distinguishing feature being the means provided for removing vessels out of the direct line of the main railway, and of depositing them upon *sub-ways*, for the purpose of being repaired. To accomplish this purpose, the upper part of the rail-way, for a length sufficient to receive a vessel, is detached from the lower part, and is made capable of revolving upon a firm, horizontal platform, a perpendicular shaft from which, passes through the upper end of the detached part of the rail-way. This platform is the segment of a circle, but it may, if necessary, present a complete circle. At the periphery of this segment, the fixed part of the rail-way terminates, and the detached revolving part commences; this is supported upon the platform, by a sufficient number of strong iron rollers, placed transversely on the lower part of the frame work, of which it is formed. The upright shaft, around which the detached rail-way is capable of revolving, is also the shaft of the windlass, by which the vessels are to be drawn up; this detached way, may therefore be considered as a radius to the circle, of which the platform is a segment.

When a ship is drawn up, and has arrived upon the moveable part of the rail-way, a power may be applied to carry this, with its load, to the requisite distance round the circular platform, until it arrives at a *sub-way*, several of which are erected around the platform, forming produced radii to the circle. These are precisely similar to the main rail-way, with the exception of their not being continued to the water, but only of such a length as to admit of the carriage, with its load, being lowered, and deposited upon them, until the intended repairs are made. In the drawing which accompanies this report, there are represented six sub-ways, and of course, upon such a structure, seven vessels might be placed at one time.

The main expense attending the erection of marine rail-ways,

is in constructing that part which is under the water, where nearly the whole of the labour must be performed in the diving bell; in the mode proposed by Mr. Clark, one principal way would be sufficient in those ports where many vessels may require to be hauled up; a considerable number of *sub-ways*, with their appurtenances, might, undoubtedly be provided, at an expense far below that which would attend the original structure. After maturely considering the subject, the committee are fully convinced of the practicability of the plan, and also of its economy, in those situations where more than a single rail-way would be desirable. When once constructed, it possesses the advantage of being capable of extension in the number of its *sub-ways*, whenever it may be required.

ROBERT M. PATTERSON, *Chairman.*

THOMAS P. JONES, *Secretary.*

Philadelphia, January 15th, 1827.

Description of the Plate of Clark's Radiating Rail-ways.

Fig. 1.—Bird's-eye view of the platform, and rail-ways.
- A, Revolving section of the rail-way, which may, at pleasure, be made to coincide, and connect with,
- BBBB, The radiating or *sub-ways*, or with
- C, The main rail-way, extending into the water.
- D, The shaft, or pivot, upon which the section A revolves.

Fig. 2.—Represents the revolving section, with its centre, as in fig. 1, together with the circular iron rail-ways, upon which the cast iron rollers are to run.

Fig. 3.—Elevation, or side view, of the revolving and permanent rail-ways, supporting a ship's carriage.
- A, The revolving section.
- B or C, Section of the main, or of the sub-rail-ways.
- D, Shaft for communicating to the windlass the power which is generated at the levers *d*. This shaft is also the pivot around which the section A is made to revolve.
- *eeee*, &c. Iron rollers, connected to, and supporting the revolving section, on the circular rail-ways.
- G, Ship's carriage, resting on the inclined rail-ways.
- H, Windlass, or other machinery for elevating vessels.
- *i*, Chain by which the carriage is drawn up.
- *k*, Palls, to prevent the carriage from running back.
- *l*, Friction rollers, flying between the moveable and fixed ways.

Fig. 4.—Ground view of a ship's carriage.

Fig. 5.—Transverse view of a ship's carriage, on rail-ways.
- *aa*, Cuneiform blocks, moveable on rollers, in appropriate grooves, to prevent lateral motion.
- *bb*, Bilge-blocks, moving on pivots, and resting on rollers adapted to *aa*.
- *cc*, Ropes, by which the cuneiform, or wedge-blocks, are drawn up, and the bilge-blocks forced against, and adapted to, the bottoms of vessels.

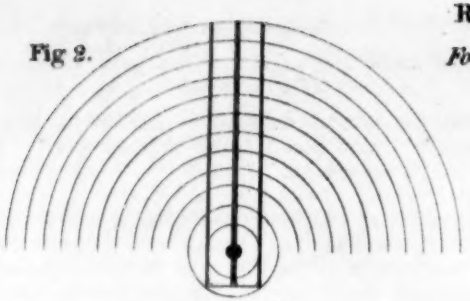
RADIATING RAIL WAYS

For the repair of Vessels,

— by —

E. CLARK.

Fig 2.



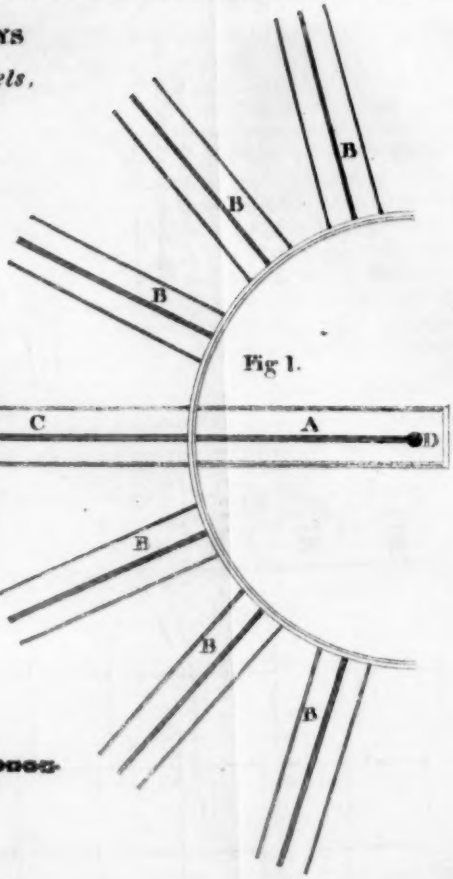


Fig 1.

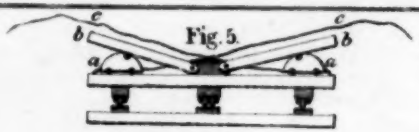
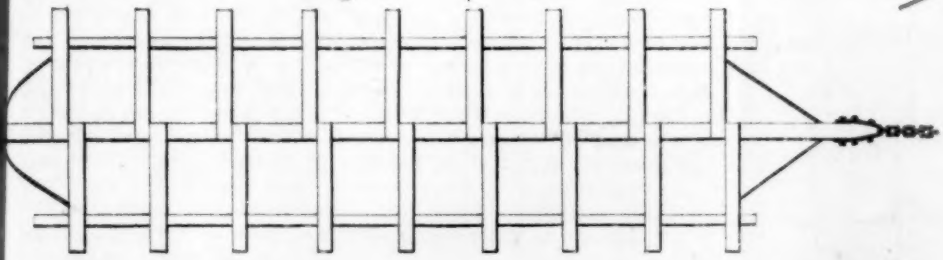


Fig. 5.

Fig 4.



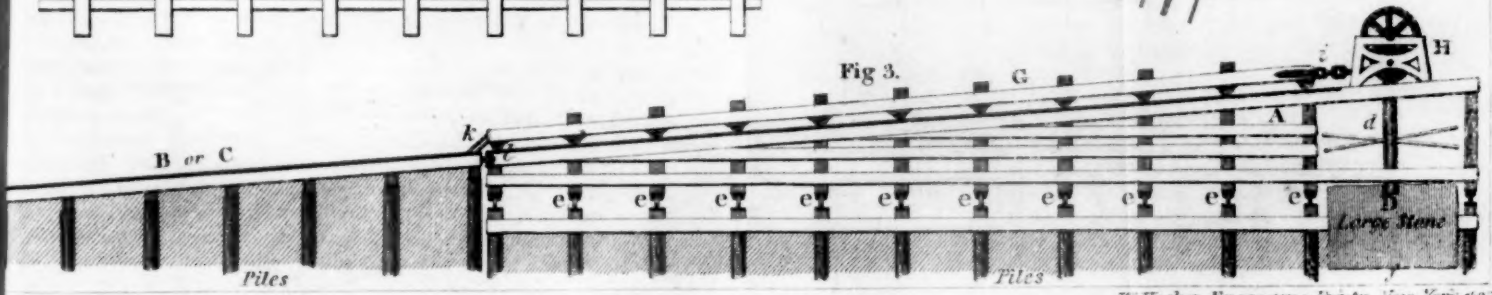


Fig 3.

W. Hooker Engraver & Printer New York 1827

COMMITTEE OF INVENTIONS.

Report on a Method for raising and lowering Canal Boats, with little loss of water; proposed by DAVID TOWNSEND.

The Committee of Inventions, to whose examination has been submitted a method for raising, or lowering, Canal Boats, without loss of water, invented by *David Townsend* of Big Beaver Falls, Pennsylvania,—

Report, That the shortness of the time allowed for an examination of the Model, in consequence of the departure of the inventor from the city, did not admit of drawings being procured; and without these it would not be possible to give a clear description of the apparatus employed; the committee, however, were highly gratified by the ingenuity which it manifested; and they will, therefore, give a general idea of the principle, upon which its action depends.

It is known to those who are conversant with the progress of canal navigation, that what has been denominated *plungers*, have been proposed for the purpose of forcing up the water in the chamber of a canal. The use of this has been adopted by Mr. Townsend in his Model, and he has contrived a very ingenious method of balancing, raising, and lowering it.

The *Plunger* is a heavy caisson, or a solid block, made of the length and width, nearly, of a canal chamber, and when adopted in practice, the chamber must be of double the ordinary width; the plunger occupying one half, and the boat to be raised, the other. When a boat from the lower canal, has entered the chamber, and the gates are closed, the plunger is made to sink perpendicularly into the water over which it is suspended, on one side of the chamber: this will, of course, cause the water to rise, and should the horizontal section of the plunger be equal to half that of the chamber, the water will rise as many feet as the plunger is immersed. A boat may be thus raised to the height of the ordinary lift of a lock, and that with no further loss of water than the unavoidable leakage of the gates.

The committee do not recollect any instance in which this plan has been adopted in practice; they, however, are of opinion that it merits more attention than it has received. They have already adverted to former proposals for the employment of the plunger; and in this particular, therefore, the invention of Mr. Townsend has no claim to novelty. Under the article *Canal* in Rees's Cyclopædia, it is mentioned that Mr. *Lawson Huddleston* had proposed a similar plan, and had contrived a counter weight, which, by its action on a snail, or spiral curve, balanced the plunger, in all its different degrees of immersion. Mr. *Robert Salmon*, also proposed to accomplish the same end, by sinking a hollow plunger, in another way; and received from the *Society of Arts*, a premium for his invention; and others have, subsequently, made similar propositions. The committee do not suppose that Mr. Townsend was acquainted with these facts, but they are not in the possession of the particulars of his claim. His mode of balancing the plunger, they believe to be new, as it differs materially from either of the plans to which they have adverted. It

has already been stated, that the particulars of this plan, cannot be described in words alone; we will therefore only state, that a strong, moveable platform, is elevated above the plunger; upon this platform weights are placed, which can be made to act upon the plunger, and cause it to be submersed its whole depth; these weights then act upon levers, which are in such a position as to exert a maximum force. When the plunger begins to rise from the water, these levers change their positions in such a way as to lessen their action, and that, in exact proportion to the decreased force of the water; and when the plunger is raised, so as to receive no support from the water, the weights retain it in this position. The committee have not thought it necessary to institute a comparison between the various plans to which they have alluded; nor would they be able so to, did they deem it desirable, as the cursory examination of the model in question, has not placed the means within their power.

By order,

THOMAS P. JONES, *Secretary.*

Philadelphia, January 15th, 1827.

FOR THE FRANKLIN JOURNAL.

MECHANICAL JURISPRUDENCE.—No. XIII.

BY PETER A. BROWNE, ESQ.

On the law of Patents for new and useful Inventions.

That acceptation of the word "manufactures" by which is intended the *method* or *manner* of making a thing, was considered in the last essay, (p. 14) and I shall now call the attention of the reader to its second meaning, which is, the *things* worked, or made. Under this head are included, 1st, new compositions of things. 2nd, All mechanical inventions.

New compositions of things, are *manufactures*, in the most common, and ordinary sense of the word; thus we say the manufacture of cloth, glass, &c. Every *mechanical invention*, or machine, is a manufacture, and is patentable, whether it be an *old* machine, or engine, which will produce a *new* and useful effect; or a *new* machine, or engine, which will produce an *old* and useful effect.

I shall not pretend to define the word machine, or engine; as an attempt to define words which are so plain, familiar, and intelligible, leads to unnecessary difficulty. We have a powerful instance of this in the cases referred to, in the last essay; where the words principle, method, engine, &c. words which are perfectly well understood, have two or three meanings assigned them, and are thus rendered obscure, if not unintelligible.

The word *manufacture*, is found in the Act of Congress, with three other words; namely, art, machine, and composition of matter. These words, without any torturing, will be found to include every invention patentable by the English law.

This is also the most proper place to remark, that the third section of the act of Congress, to the word inventor, found in the British statute, adds that of *discoverer* of any art, machine, &c. and the second section does not limit the author to the "working or making," as in England, but provides for the "*making, constructing, using,* and *vending* to others to be used, the *invention* or *discovery.*"

A patent may be taken for an *improvement* or *addition.*

In England, it was formerly held, that a patent could not be for an *improvement* or addition. Lord Coke in 3d institutes, 184, says, "but if the substance was in esse before, and a new addition thereunto, though that addition make the former more profitable, yet it is not a new manufacture in law." He relies on Bircott's case, in the Exchequer Chamber, in the 15th year of Elizabeth. This case was decided before the passing of the statute of James.

Morris v. Branson, was tried in 1776; it was respecting a patent for making oilet holes, or net work, in silk, thread, cotton, or worsted; and the defendant objected that it was not a new invention, it being only an addition to the old stocking frame. Lord Mansfield, after one of the former trials on this patent, said, "I have received a very sensible letter from one of the gentlemen who was upon the jury, on the subject, whether on principles of public policy, there can be a patent for an addition only. I paid great attention to it, and mentioned it to all the judges. If the general point of law, viz. that there can be no patent for an addition, be with the defendant, that is open upon the record, and he may move in arrest of judgment. But that objection would go to repeal almost every patent that ever was granted."

There was in this case, a verdict for the plantiffs, with £500 damages, and no motion was made in arrest of judgment. Though his lordship did not mention what were the opinions of the judges, or give any direct opinion himself, yet we may safely collect, that he thought, on great consideration, the patent was good, and the defendants' counsel, though they had made the objection at the trial, did not afterwards persist in it.

Bircott's case is thus noticed by Buller, J. in 2 Henry Blackstone's Reports, 488, "That a patent for an addition, or improvement, may be maintained, is a point which has never been directly decided; and Bircott's case, 3 Inst. 184, is an express authority against it. What were the particular facts of that case, we are not informed, and there seems to me to be more quaintness, than solidity, in the reason assigned; which is, that it was to put a new button to an old coat, and it is much easier to add than to invent. If the button were new I do not feel the weight of the objection, that the coat on which the button was put, was old. But in truth, arts and sciences, at that period, were at so low an ebb, in comparison with that point to which they have been since advanced, and the effect and utility of improvements so little known, that I do not think that case ought to preclude the question. In later times, whenever the point has arisen, the inclination of the Court has been in favour of the patent for the improvement, and the parties have acquiesced, where the objection might have been brought directly before the court." He then cites Morris

v. Branson, as above stated, after which he proceeds—"Since that time (1776) it has been the generally received opinion in Westminster Hall, that a patent for an addition is good."

Lord C. J. Eyre, speaking of Bircott's case, says, "The principle on which that case was determined, has been, as my brother Buller observes, not adhered to, viz. that an addition to a manufacture cannot be the subject of a patent."

In Hornblower v. Boulton, 1799, Grose, J. remarks—"But a doubt is entertained, whether there can be a patent for an *addition* to an old manufacture; this doubt rests altogether upon Bircott's case, 3 Inst. 184, and if that were to be considered as law at this day, it would set aside many patents for very ingenious inventions, in cases where the additions to manufactures before existing, are much more valuable than the original manufactures themselves. I shall content myself with referring to what Lord Chief Justice Eyre said in this cause, in the Court of Common Pleas, in answer to this, and to the case of Morris v. Branson, cited by my brother Buller upon the same point. If, indeed, a patent could not be granted for an addition, it would be depriving the public of one of the best benefits of the statute of James." Lord Coke's opinion, therefore, seems to have been formed without due consideration, and modern experience shows that it is not well founded.

A patent had been granted in the 27th year of King George III, for a machine for the manufacture of woolen cloths. In the 34th George III, another patent was granted for *improvements* upon that machine. Upon a motion to dissolve an injunction, obtained by the patentee, an objection was taken to the specification under the latter patent, as describing the machine with the improvements, as one entire machine, the subject of that patent; not distinguishing the original machine, from the improvements. The answer admitted, that the improvements were new, substantial, and a greater saving of power; and that the description in the specification of the machine with the improvements, was accurate, and intelligible; so that the machine could be made according to that description. The Lord Chancellor, in delivering his opinion, says, "I do not enter into the question, whether a patent for improvements can be supported. *The affirmative has long been settled, and undoubtedly is the law.*" 14th Vezey's Reports, 133, Harmer v. Plane.

The case of Fox, ex parte, in Vezey & Beame's Reports, 67, was a patent issued *by order of the lord Chancellor*, for certain *improvements* in steam engines.

I rather think, therefore, that no risk is incurred by laying down the English law to be, that a patent for an improvement, or addition, is valid.

The case of an improvement, is expressly provided for by the American Law. The 1st section of the act of Congress of 1793, enacts, "That when any person or persons, being a citizen or citizens of the United States, shall allege, that he or they have invented any new and useful art, machine, manufacture, or composition of matter, or any new and useful *improvement* on any art, machine,

manufacture, or composition of matter, not known or used before the application; and shall present a petition to the Secretary of State, signifying a desire of obtaining an exclusive property in the same, and praying that a patent may be granted therefor, it shall and may be lawful for the said Secretary of State, to cause letters patent to be made out," &c.

But the patent is valid only for the improvement, and gives the patentee no title to use the original invention.—This was laid down by Buller in the case of Boulton & Watt v. Bull, formerly quoted; where, to what was before noticed, he adds the following observation. "But then it (the patent) must be for the *addition only*, and not for the old machine too."

Jessop invented a watch movement, and he took out a patent for the whole watch, and his patent was avoided. Cited by Buller, J. in Boulton & Watt v. Bull. So in the case of Harmer v. Plane above mentioned, the Lord Chancellor, after stating, that it had long been settled that *improvements* were patentable, and that the second patent would subsist till 1808, says, "but the original instrument without the improvements, was open to the public in 1801."—14th Vez. 138.

This also is expressly provided for by the act of Congress, section 2d. "Provided always, and be it further enacted, that any person, who shall have discovered an improvement in the principle of any machine, or in the process of any composition of matter, which shall have been patented, and shall have obtained a patent for such improvement, he shall not be at liberty to make, use, or vend the original discovery, nor shall the first inventor be at liberty to use the improvement."

The patent must not be broader than the invention, or it is void.—Conformably hereto, the law was adjudged by Judge Story, in the case of Whittemore v. Cuttee, 1 Gallison's Reports, 478. "If the plaintiff, Amos Whittemore, be not the inventor of the whole machine, but only of an improvement thereof, his patent is too broad, and is utterly void; for it is clearly a patent for the whole machine."

And in like manner in Woodstock v. Parker, 1 Gallison's Reports, 438. Story, J. observes, "If the machine for which the plaintiff obtained a patent, substantially existed before, and the plaintiff made an improvement only, therein, he is entitled to a patent for such improvement only, and not for the whole machine: and under such circumstances, as this present patent is admitted to comprehend the whole machine, it is too broad, and therefore void."

As to what shall constitute an improvement, the same section declares, "that simply changing the form, or the proportions, of any machine, or composition of matter, in any degree, shall not be deemed a discovery."

So in Woodstock v. Parker, 1 Gallison's Reports, 438, Judge Story observes, "It is not necessary to defeat the plaintiff's patent that a machine should have previously existed *in every respect similar to his own*, for a mere change of *form*, or *proportions*, will not entitle a party to a patent."

So in Pettibone v. Derringer MS. Rep. C. C. U. S. one of the

questions submitted by Judge Washington to the jury, was, whether the twisted auger, of which the plaintiff claimed to be the inventor, was an improvement in the principle, or merely a change in the form and proportions; in which latter case, the patent was not good.

What constitutes the identity, or diversity, of two machines, so as to give, or take away, the right to a patent, is a question of fact, sometimes difficult of solution. To assist in its decision, Judge Story, in the case last cited, gives the following rules. "Where a specific machine already exists, producing certain effects, if a mere addition is made to such machine, to produce the same effects in a better manner, a patent cannot be taken for the whole machine, but for the improvement only." The case of a watch is a familiar instance. "The inventor of the patent lever, without doubt, added a very useful improvement to it; but his right to a patent could not be more extensive than his invention. The patent could not cover the whole machine as improved, but barely the actual improvement. The illustration might be drawn from the steam engine, so much improved by Messrs. Watt & Boulton. In like manner, if to an old machine, some new combinations be added, to produce new effects, the right to a patent is limited to the new combinations."

Where a patent is taken out for improvements in several different things, if there be defect in the title to any one improvement, the patent is wholly void.—This was decided in Brunton v. Hawkes, 4 Barnewall & Alderson's Reports, 544.—This was an action brought to recover damages for infringing the plaintiff's patent right to certain improvements in the construction, making, or manufacturing of, ships' anchors and windlasses, and chain cables or moorings. It appeared upon the trial, that so much of the plaintiff's improvement as related to the anchor, was not new. A verdict was found for the plaintiff; and afterwards, upon a motion for a new trial, the question was discussed, whether, there being no novelty in the mode of manufacturing the anchors, and the patent being granted for these three several things, if void as to one, was not void for the whole. Abbott, C. J. gave his sentiments as follows. "It is not without great reluctance that my mind has at length come to a conclusion, which (as far as my judgment goes) will have the effect of avoiding this patent. It appeared in evidence, at the trial, that the mode of making cables and anchors, introduced by the plaintiff into general use, was highly beneficial to his majesty's subjects; and I should wish that he, who introduced it, might be entitled to sustain the patent. Upon a full consideration of all the arguments that have been addressed to us, and a view of the patent, the specification, and the evidence given at the trial, I feel compelled to say, that I think so much of the plaintiff's invention, as respects the anchor, is not new; and that the whole patent is therefore void." And afterwards, "The question then is, whether, if a party applies for a patent, reciting that he has discovered improvements in *three* things, and obtains a patent for the three things, and in the result it turns out that there is no novelty in *one* of them, he can sustain his patent? It appears to me that the case of Hill v. Thompson, 2 Bayley Moore, 424, which un-

derwent great consideration in the Common Pleas, is decisive upon that question. The only difference between that case, and this, is, that here, the plaintiff, instead of saying that he has made certain improvements, *states the improvements;* but still he claims the merit of having invented improvements in all the three. The patent is granted upon the recital that he has made improvements in all the three, *and that they are new;* and the consideration of the patent is the improvement in the three articles, and *not in one;* for an improvement in only one of them, would render the patent bad. The consideration is the *entirety* of the improvement of the three; and if it turns out there is no novelty in one of the improvements, the consideration fails in the whole, and the patentee is not entitled to the benefit of that other part of his invention. For these reasons I am of opinion that the patent cannot be supported." Bayley and Best, Justices, were of the same opinion.

The question of identity, or diversity, of inventions, is a *mixed* question of *fact* and *law*. It is a question of fact to be proved by witnesses, who are to explain the precise agreements, and difference, between the given machines; and all the facts being given, it is a question of law, whether the principles are the same.

This rule is well elucidated by Judge Story in the case of Barrett v. Hall, in 1 Mason's Reports, 471—2. Where he says, "But, although the testimony of witnesses be admissible, to prove the identity, or diversity, of machines, in principle, yet, after all, it is but matter of opinion; and its weight must be judged of by all the other circumstances of the case. It is infinitely more satisfactory to ascertain, if we can, the precise differences and agreements; and when these can be subjected to the eyes, they almost supersede all the evidence of mere opinion. In all my experience, I can scarcely recollect a single instance, in which the general question, whether the principles of two machines were the same, or different, has not produced from different witnesses, equally credible, and equally intelligent, opposite answers. This could result only from the different meanings attached to the word, and from confounding its various senses. And this has been completely shown when the same witnesses came to explain the precise agreements and differences, in which they have almost uniformly agreed. The case now before the court is a perfect proof in point."

The witnesses differed as to the identity or diversity of the principles of the machines, but they all agreed in what were the precise differences and agreements, in fact. There seemed then nothing for the jury to decide.

FOR THE FRANKLIN JOURNAL.

Remarks on the coating of Iron with Copper.

LEBANON, JANUARY 22, 1827.

Mr. Editor.

SIR---Through the politeness of a friend, I have been gratified with the perusal of the Franklin Journal for January, 1827, in which I

find a notice of a patent obtained by Mr. David Gordon & William Bowser, Iron Manufacturers, London, for a method or process by which iron is coated with copper, and which is stated as a valuable discovery in the arts, &c. It may, probably, be a valuable discovery; but I am apprehensive, that there must be considerable difficulty attending the process, inasmuch as the iron has to be heated to a degree that will cause it to oxidize rapidly, unless entirely excluded from the air, which appears to me almost impracticable.

The following process I have been acquainted with for a number of years, and I think it much more simple, much more expeditious when any quantity of the article is required, much less expensive, and attended with much less risk; whilst it requires but little skill in the performance. Take a cistern of wood, of a size suitable for the articles required to be coated; fill it with rain, or river water; put up a small furnace; the best form, I think, is that used in rolling mills for heating iron, with anthracite coal, but it need not be more than one-third of the size. Any other kind of fire, that will produce a uniform heat, may answer; then take scraps of sheet copper, or any other copper most convenient, heat them to a bright red, sufficient to oxidize the surface, but not to melt the copper, then quench them in the cistern of water; continue to heat, and quench them, until more than a sufficient quantity of copper is oxidized and disengaged, to coat the articles required; stir the water well, and deposite the articles intended to be coated, in such a position that they will be entirely covered, and the water have free access to every part: leave them in this situation, from five to ten days, and they will be completely coated with copper. A kettle, for instance, made of sheet iron, and deposited in the solution, will become completely coated inside and out, and will appear as if made of sheet copper. The longer the articles remain in the solution, the thicker will be the coating, at least so far as my experience goes. If you should think the above worthy a place in your useful Journal, it is at your service; if not, dispose of it as you think proper. I am no patent-monger, neither do I intend to become one; they are already too numerous, their contrivances, in general, serving as proofs of idleness, rather than of genius.

Yours, &c.

JOSHUA MALIN.

P. S. I have lately invented a pyrometer, for measuring the contraction and expansion of metals, &c. it is very simple, and easily constructed, yet I think very accurate. I have not seen, or heard of any one upon a similar plan, and shall take the liberty of sending you a description of it, as soon as I have leisure.

J. M.

Remarks by the Editor.—If *blue vitriol*, (sulphate of copper) be dissolved in water, and a clean piece of iron or steel, such as a knife blade, be dipped into the solution, the iron, or steel, will become coated with copper; in this case a portion of the acid, by which the copper was

dissolved, combines with and dissolves a portion of the iron, whilst the disengaged copper, taking its place, is precipitated upon the surface of the remaining iron, which it completely coats. This coating, however, will neither be thick, or durable, and is very different from that proposed in the patent. In the process recommended by our correspondent, there is no acid employed, and consequently no salt of copper formed; in what way the copper, in the state of oxide, becomes reduced, and combines with the iron, we cannot perceive. We should apprehend, that the only action in the case alluded to, must result from the accidental presence of acid, and that in *pure* water, there would be no sensible action. Our correspondent appears to speak from his own experience, and in this, should there be no mistake, he offers a much better test than our theory; as theories are good only so far as they are suggested, and supported by experience. The communication omits to mention, the necessity of a *perfectly clean* surface of iron; without this, however, no coating can be expected. We should be glad to *see* an article covered with copper, by the foregoing process.

FOR THE FRANKLIN JOURNAL.

Observations on Mill Spindles, and on Brands.

BRANDYWINE, 1st MONTH 16th, 1827.

To the Editor.

ESTEEMED FRIEND,—In looking over the Franklin Journal, pages 370, 371, for Dec. 1826, I observed an article on Mill Spindles, with a draft of one, and some observations on its utility, and recommending some precautions that I consider unnecessary, and of small value. I have been a Miller for nearly 40 years, and for the last 16 of the time, I have made use of cast iron, extensively, in the Mills that I have been, and am now engaged in, for wheels, gudgeons, and spindles, as well as for *steps* for those spindles; all which are *cast* iron throughout; the cock-head, neck, and toe, being all of the same piece of metal, cast at the same time; all of which have worn, very well, for 16 years past; having given us very little trouble. Had I now a new mill to build, I should use the cast iron spindles, &c. in preference to any others. It has occasionally been necessary to introduce new steps, as they *bore* down faster than the toes wear, but this has occasioned us little trouble, as we have a pattern of wood provided, and several extra steps at hand, which we put under the spindle, rough as they come from the furnace, (except cleaning out the sand that had adhered to the iron in casting) adding a small quantity of *ground emery* and oil; in this state the spindles are permitted to run (without the stone) for an hour or two, when they are lifted up and the emery cleaned out, and oil put in the steps; they are then ready for work, in the usual way. Our *brands* are also of cast iron, and they have been found to answer our purpose very well for many years, changing them as they burn out; this is done

very readily, as we always have some to spare, they being prepared at the furnace with a wrought iron bar about 15 inches long, to which we weld the old handle, when we find it necessary to make use of a new brand. I need make no further observations, than that the steps of the spindles ought to be cast of the *hardest* iron: and in relation to the brands, that in casting, the end of the bar of wrought iron should be *split* in *four* parts for an inch, and opened a little, and the brand cast *upon that end*, to prevent their becoming loose, which they are likely to do without this precaution.

A cast iron brand costs about *half* as much, and will last about half the time, of one that is wrought, and *cut*. But there is, in various respects, a great advantage in having two brands instead of one.

J. Morton Poole.

ESSAYS ON MATHEMATICS.

By the late Mr. John Cross, *Teacher of Mathematics, Glasgow.*

No. II.

In every age and country where learning has prevailed, the mathematical sciences have been esteemed as forming an extensive and valuable part of human knowledge. Their influence on the mind, independent of their practical utility in life, is alone sufficient to place them on a level with most other studies. They accustom the mind to attention. In the pursuit of this study, we are delighted with a succession of connected truths, which are evident when we understand the reasoning, but which do not appear at first sight to depend on each other. The pursuit of truth, gratifies a faculty implanted in us, as much as the pleasing of our senses; and the pleasure which we by that means derive, is free from the regret, the turpitude, and the intemperance which often attend sensual pleasures. When any one has felt pleasure, he will naturally wish for a repetition of it; but this he cannot have, unless he understands the reasoning by which any thing is shown to be true; and as mathematical truths are not obvious, he will be incited to study the reasoning by which any conclusion is aimed at. Attention is requisite for this purpose; and by endeavouring to attend closely to one subject, a habit of attention will soon be established.

By mathematical knowledge we acquire a habit of clear, demonstrative, and methodical reasoning. If we look into controversial writing, hear verbal disputes, or examine the foundations of many ingenious systems, we shall be surprised at what superficial reasonings satisfy the greatest part of mankind. The method of convincing which is often adopted, is to work upon the passions, rather than the judgment. A piece of wit, an anecdote, or a simile, is often advanced in place of solid sense. You may hear a subject, abundantly plain, obscured by reasoning the most foolish; and often you may see a man of plain common sense supporting a position, which scarce re-

quires proof, silenced by the noise or the laugh of his opponent, or knocked down by a quotation from Shakspeare or Hudibras. If with this we compare the reasoning of the geometrician, we shall find it is conducted in a manner diametrically the reverse.

From a few simple axioms and self-evident principles, we proceed gradually to the most general propositions, and remote analogies; deducing one truth from those already known, in a chain of reasoning infallibly connected, and logically pursued; and truth agreeably forces itself upon the mind, in the full tide of irresistible conviction.

By an attachment to these studies, we acquire an elevation of thought which fixes the mind, and prepares it for other pursuits; we follow with pleasure the same closeness of argument in other researches; and if we find a want of this accuracy, our mind, accustomed to the contemplation of truth undisguised, revolts indignant from the merely probable, the false or erroneous assertion, and reason disdains to assent to the sophisticated tale.

It is true, indeed, that in most other subjects, the same strictness of reasoning is impracticable, because their principles do not admit of the same degree of evidence; but still it is imitable in a certain degree. For proof of this I need only appeal to those works, the authors of which were mathematically inclined. Of these I shall only notice Smith's Wealth of Nations, Reid's Essays on the Powers of Man, and the writings of Dr. Beattie.

What has been said may recommend mathematics, as a useful exercise to the mind; the exercise of our mental powers is as necessary for giving a vigorous constitution of mind, as bodily exercise is for procuring health and strength to our frame. But it is not merely in a speculative view that the study of mathematics is advantageous; its application to other sciences and the arts, have given rise to many inventions, which are useful in every department of life.

The importance of mathematics as a preparation for other sciences, will be evident on considering their connexion and dependence on mathematical principles. We may observe, that all the objects of our knowledge are made in number, weight, and measure, and therefore to consider them we ought to understand arithmetic, geometry, and statics; and the greater advances we make in those arts, we are the more capable of considering such things as are the ordinary objects of our conceptions. But particularly we now know, with astonishing precision, the courses, periods, order, distances, and proportions of the several great bodies which compose our planetary system, at least of such as are within our view; and this affords a remarkable instance of the power of arithmetic, and geometry, well applied. Let us suppose ourselves placed at that stage of society, when the long course of observation and study necessary to bring astronomy to its present perfection, had yet to begin;—let us suppose ourselves ignorant of the most obvious revolutions and motions of our planet;—let us suppose ourselves ignorant of its periods and seasons, without instruments to make observations, without any idea of observations or instruments;—when would we expect that any of our posterity should arrive at the art of predicting an eclipse? When would we suppose them ca-

pable of reckoning all the eclipses, past, or to come, for any number of years? When would we suppose that if conveyed to any distance from their home, that they should be able to tell how far from it they were, south, north, east, or west, or what course to take to return? We know that all this may be done, and is daily done, by what is known in astronomy; yet, when we consider the vast industry, sagacity, and the multitude of observations necessary for these purposes, we would be inclined to give up the pursuit as impossible to be attained; but by the assistance of the mathematical sciences, these things are now rendered so easy, that they may be performed by ordinary understandings.

What has been said of astronomy is equally true of geography and of navigation, sciences which depend upon astronomical and mathematical principles. To chronology these sciences are equally necessary; from the occurrence of circumstances related in many parts of ancient history, the precise dates have often been ascertained when some remarkable events have taken place. Thus Mr. Halley determined the day and hour of Julius Cæsar's landing in Britain; and the accounts of ancient eclipses, have, by this means, enabled us to tell exactly the dates of some events in history, which, without this verification, might be reckoned fabulous. Thus, in order to read history with advantage, some knowledge of geography and chronology are necessary.

Light is a considerable object of natural knowledge; but all inquiries concerning this body, are frivolous and futile, unless guided by geometry. I am not to be understood here as speaking of the ingenious theories of the chemists concerning this wonderful substance—with these, the geometers have nothing to do; but they have discovered two of the principal laws of its action, *viz.* in the reflection and refraction of its beams, and have invented the beautiful theory of optics, and of reflected and refracted vision, and have taught us to manage this subtile body, for the improvement of our knowledge, and for purposes useful in life. Geometers have likewise demonstrated the causes of several celestial appearances which arise from the inflexion of its beams, both in the planets, &c. and in the phenomena which arise in the atmosphere of our earth. Of the fluids which surround, or float upon the surface of the globe which we inhabit, air and water, little could be known but for the assistance of geometry and mechanics. The elasticity, and gravity, of air have been discovered by mechanical experiments. From these properties, geometricians have calculated the height of the atmosphere, as far as it has any sensible density, and the result agrees with another observation on the duration of the twilight. Air and water are the objects of hydrostatics, though denominated only from the latter. The principles of this science were established by Archimedes, and by the science is illustrated those natural appearances which depend on the gravity and motion of fluids, and the motion of solids in these fluids; in considering the different pressures, celerities, and resistances of these solids, many practical observations have been pointed out, necessary for the business of naval architecture; and the solid, which shall pass through a fluid with the least possible resistance, has been

ascertained. The calculations of mathematics on the motion of water through pipes, &c. are useful for several purposes. I might enumerate other arts and sciences which depend on mathematical principles. Thus perspective depends upon the rules of geometry and optics. The mathematics have reduced music to a regular system, by inventing its scales; and there is hardly any part of mathematics which is not subservient to architecture. I might descend to the animal frame. The eye, the only organ of sense which the geometers have considered, is the only one whose structure and manner of operation are understood.

Every anatomist who would wish to understand the action of the bones and muscles, would need the knowledge of mechanics.

The usefulness of mathematics in several sciences and practical arts, is abundantly evident. They were reckoned by some of the ancient philosophers the key to all knowledge. Thus Plato had written above the door of his school, "Let no one ignorant of geometry enter here." It is not meant, however, that a knowledge of mathematics will enable any person to practise in any of the arts I have mentioned. Thus he who would attempt to compose music merely by his knowledge of harmonical numbers, could not be expected to produce very excellent pieces. To excel in several of those arts, besides the accuracy of rules, a person must be possessed of genius and fancy, and practice is necessary for them all. Yet still they owe their being to mathematics, which lays the foundation of their theory, and affords them precepts, which being once invented, are depended upon securely by practitioners. Thus, though many design who do not know the reasons of the rules by which they practise—though many compose music better, perhaps, than the inventor of the scale could have done, and know nothing of the numbers on which their harmony is founded, yet as the mathematics show the foundation of these arts, they must be necessary for their improvement; and surely it will be granted, that he who knows the fundamental principles of what he professes, has the best chance of excelling.

Hints to Paviers. *By* Colonel Macironi.

[Continued from page 58.]

The next kinds of pavement that it may be necessary to mention, are those of Florence, of Sienna, of Milan, and some other cities of Northern Italy. These may, indeed, be assimilated to a kind of stone rail-road, as there are particular tracks allotted for the wheels, and others for the horses. The tracks for the wheels are composed of stones of very large dimensions; they are of marble, lumacelar limestone, or of a very hard sand stone; most of them, particularly at Florence, weighing several tons. They are laid with much precision, in lines of about three feet broad. The spaces for the horses, between these lines, are paved with small stones, and are, as well as I can recollect, about four feet wide. In some of the squares, the small pavement predominates; while the lines of large stone-way

cross it in every necessary direction. Nothing can be more easy or agreeable than this pavement, which is suitable to carriages of every description, without the limitation or confinement of an iron rail-road, but with nearly the same smoothness.

Among the causes which appear to me to have contributed to the extraordinary duration of these ancient Roman pavements, the geological nature of the surface over which they are constructed is not the least prominent. With the exception of the Pontine Marshes, and some tracts about Brindisi (Brundusium), Taranto, and Peruggia, nearly the whole of them have been carried over a surface of volcanic tufa, of greatly compressed Puzzolana, or of calcareous, or basaltic rock; all which furnish the best possible foundation. In countries where chalk, clay, gravel, or sand, are frequent at the surface, as in England, France, Alsace, part of Lombardy, &c., even these Roman pavements, when not kept in repair, have speedily become impracticable for carriages.

The size and weight of the stones composing the ancient Roman pavements, certainly do, *when once well laid on a compressed substratum*, oppose much *vis inertia* to the weights which roll over them, while their polyangular shape prevents any acute, or even right angles, being presented to partial pressure. This polyangular shape, and the excellent juxta-position of their sides, prevent any continuous line of junction being presented to the course of the wheels, which would so much tend to create ruts, and other irregularities; moreover, the stones being slightly pyramidical, produces a tendency to conduct the shocks towards the inferior centre of each, or laterally to the superior edges, which are well supported by the surrounding ones.

It is necessary also to remark, that the carriages used in Italy, both anciently and at the present time, are what would be deemed in England, very light. Besides which, the wheels of the modern Roman and Neapolitan carts are of a larger diameter than any used in England. It would appear that the carts of the ancient Romans were generally two-wheeled, drawn by two, or four oxen. Travelling was for the most part performed on horseback, or in litters carried by two mules. Chariots for travelling do not appear to have been used at all, much before the close of the republic. They were both two and four-wheeled, but not made to carry more than two persons, besides the driver. They do not appear to have had any springs; the wheels were very low, and not more than thirty-two or three inches apart. So that, altogether, it may be presumed they were more calculated to bruise the bones of the riders, than injure the pavements over which they bounced.

Such, in a very few words, are the best pavements I have had an opportunity of observing, and there is reason to believe there are no better existing. It does not, however, follow, because they are good, and perfectly well adapted to their respective purposes and localities, that any of them might be applied with advantage to the streets of London. I think it may be easily shown, that neither the ancient

nor modern Roman, the Tuscan, nor Neapolitan, would possess the qualities required for such an application.

To pave London after the ancient Roman plan, would, in the first place, be attended with enormous expense, and entirely new stones would be required for the whole undertaking. Stones of so large a surface would also become most dangerous for horses, at any pace faster than a walk, or when drawing heavy weights, or upon an acclivity. In London, wagons and carts are in general use, of far greater burthen than any which were anciently, or are at present, used in Italy. Some of our stages and vans, to a very considerable weight, moreover, add great velocity. I shall be told, perhaps, that in proportion to this horizontal velocity, the vertical gravitation is diminished; but these carriages have very small fore-wheels, upon which the drivers, with extraordinary stupidity, contrive to place the greater part of the load.* Such small wheels, so overloaded, descend with great violence into the least depression of the pavement, and are thrown up (to fall again) by the slightest protuberance.

I very much doubt whether, even in point of durability, either the Roman or Neapolitan pavements would succeed in London. Considering the friable nature of most descriptions of mortar, I suspect, that the repeated shocks of very heavy carriages would pulverize and detach it from the inferior surface of the stones, part of it would work out, and the stone become loose.† A further great objection to any such solid masonry pavements is, the frequent necessity of partially taking it up to lay gas and water pipes, and to repair our trumpery, crumbling, brick sewers.‡

The foregoing objections will equally apply to the modern Neapolitan pavements. The modern Roman has not the defect of being too smooth, but it has that of homogeneous solidity, which will not admit of its being perpetually displaced for the temporary purposes above mentioned. Moreover, where are we to get a sufficient quantity of such Puzzolana mortar as is employed in Italy, with which the pavement becomes as one rock?§

With regard to the pavements, or, as I have ventured to call them, the stone rail-ways of Florence, Sienne, Milan, &c. &c. the objec-

* The pertinacity with which this custom is followed, is somewhat surprising in this scientific country. What are we to say to the riders too? We frequently see five or six in front on a stage coach, without a single person behind, or even inside!

† I have seen portions of ancient Roman road broken up by the passage of heavy artillery. A very few such large stones displaced, will render the road impassable for carriages.

‡ Our sewers are admirably planned and levelled, but the materials and the construction are very short of the necessary solidity.

§ I have frequently seen portions of such pavements undermined, and displaced by torrents, without a single stone being detached from the masses of several square yards' surface, into which the pavement was broken. On one occasion I remember the water having undermined the whole breadth of pavement, so as to admit of my crawling under it from one side to the other. I immediately after passed over it in my carriage, as safely as over a bridge.

tions to their adaptation to the streets of London must also be obvious enough. Independently of the enormous expense of the materials, such a system could never answer in streets where vehicles of all descriptions, going at every degree of velocity, have occasion to cross, pass, and run abreast of each other, over the entire breadth of the street. Such large stones, whether of granite or limestone, would soon become dangerously smooth, their longitudinal edges would wear, and ruts continually be formed along them.*

It remains for me to observe a new method of paving, which has been lately attempted in Piccadilly, but which I am confident will not be found to possess any advantages over the old plan in general

* In that delectable imitation of the French, which is exhibited on the Hammersmith road, of which one portion is paved and the other not, the high ridge, which must perpetually exist at the edge of the paved portion, has afforded many good jobs to the surgeons and wheelwrights. *A propos* of French roads—I will venture to digress so far as to observe, that with the exception of their straightness, their construction in other points is very bad. They are in general three times too wide—they are too much arched or elevated in the middle, and when this part of them is paved, nothing is done to the lateral portions, which are not. From being too wide, so much care cannot be bestowed on their construction, at the same expense as would suffice were they narrower. Secondly, the carriages and carts not being obliged to get out of each other's way, form regular tracks and ruts for those going and those coming, out of which they never dream of moving. These French carts and wagons are of quite as barbarous and rude a construction as they could have been in the days of Clovis or Charlemagne, save and except, peradventure, that very ingenious invention of the modern French, for the express purpose of enabling the said carts to keep exactly and undeviatingly in the same ruts. For whereas in different districts the carts vary more or less in width, so that cart A would not be able to go exactly in the rut of cart B, it is contrived, that their axletrees should have six or seven inches to spare, over and above the portion confined in the nave of each wheel. The linch pin is affixed to the extremity of the axle, so that the wheels are at liberty to wash to and fro from side to side, and adapt themselves exactly to the ruts, which the French road-makers so highly appreciate. In passing by a French cart you must therefore be careful to allow for, at least, six inches of concealed axle, which ever and anon darts out from the nave, like the tongue from the mouth of a snake.

The middle portion of a French road, which is generally paved, is so much arched, that carts are naturally induced, if not compelled, to take the centre of it; so that those going in opposite directions invariably use the same track, out of which they only momentarily move at the instant of meeting. Deep ruts are thus soon worn even in the most substantial pavement—the difficulty of repairing which, unless throughout the whole extent at once, must be sufficiently obvious. I have here alluded only to the two or three main roads of France. In the others, which they regard as secondary ones, I have travelled for scores of miles where the ruts have been so deep, that on one of my wheels falling in, it could not touch the bottom, but rested on the nave and axle.

Besides the consequences of the defects of locality and of materials, I have remarked three principal causes of the speedy deterioration of highways. Their being too wide—too much arched—or having but little traffic upon them;—all which circumstances conduce to the carriages keeping in one track, and to the consequent formation of ruts and holes. The only defect in the English high roads, is their having so many unnecessary, and often dangerous turnings and windings. Here and there, they are even too narrow; and buildings have been suffered to encroach upon them.

use, *at all commensurate to the great inconvenience and expense attending its formation.* According to this method, the old pavement is taken up for a space of about thirty or forty yards at a time, and a regular road is laid with gravel and broken granite, *à la M'Adam*, upon which the paving stones are subsequently laid, and the operation repeated for another forty yards. It, however, takes at least ten days or a fortnight to harden in succession each of these tracts, sufficiently for the application of the paving stones, and these successive hardenings are to be performed by the carts, carriages, and horses of the public, with so much inconvenience and annoyance as amount to a complete nuisance! After all, this pavement of such troublesome and *expensive* production, will not stand much longer than the old. When any portion of it has to be taken up, for pipe laying, &c., how is that portion to be restored to an equal density with the rest? In fact, there is no species of pavement that I have ever seen or heard of, to the application of which to the streets of London, there would not be many great objections. I, however, flatter myself, that, after much observation and reflection, *I have hit upon a method that would combine economy with durability, and with what is here quite indispensable, the admissibility of partially and frequently disturbing it, with no greater inconvenience or expense than occurs according to the present system.*

Having thus far therefore endeavoured to show, that solid cement-laid pavements, or even such as derive their solidity from the size and weight of the stones, would severally present many objections to their adaptation to the streets of London; I now will proceed to state what I conceive would prove a cheap and efficacious succedaneum.

The author then proceeds to give the explanation of his system of pressure, which has been already inserted in our last number, p. 58.

ESSAYS ON BLEACHING.

By James Rennie, A. M. Lecturer on Philosophy, &c. &c. London.

No. II.—BLEACHING APPARATUS.

Section II.—The apparatus for preparing the different combinations of chlorine with the alkalies, with lime, or with water, has also been somewhat improved since its first invention by Berthollet, but this has only been the case in the materials used for its construction, and in some of its less important parts: the principles on which it is now made, are the same as in the earliest periods of its employment. Mr. Rupp, (Manchester Memoirs, V. p. 301, in a note,) complains of Berthollet's apparatus as too complex for a manufactory, and recommends a range of four, five, or six hogsheads, or rum puncheons, connected with one another in the manner of Woulfe's apparatus, as being greatly preferable. It will be recollected that this is exactly the method which was resorted to by the Aberdeen bleachers, when they found it inconvenient to use glass.

The one now commonly used is said by Ramsay to have been contrived by Mr. Fisher of Ruthergien; that which I shall now describe as the best which has come to my knowledge, is somewhat different from Mr. Fisher's as described by Ramsay, and is that used by the most enlightened bleachers in England and Ireland. Over a furnace constructed in the usual way, is placed a cast iron vessel containing water, which forms a water bath for the reception of a still. This still, into which is put the materials for furnishing chlorine, is made of lead, and properly adapted, both in form and size, to the cast iron water bath in which it stands. The top of the still is furnished with water lutes, to keep the apparatus tight and prevent the gas from escaping. These lutes are best made of loose flax, dipped in white lead which has been ground in oil. The head of the still is also of lead, and is sufficiently large to allow of its dipping, six inches, into the gutter of water which surrounds the body of the still; whence it can be taken off, or put on at pleasure. In the top is made a circular hole of three inches diameter, to introduce the materials, and occasionally to clean out the still. The whole is fitted with a plug of lead, which is gently struck into the cover when the apparatus is arranged for working, and is luted with soft clay to prevent the escape of gas. To agitate the materials, there is fixed in the still, a *stirrer*, consisting of a square frame of wood covered with lead. From the still there runs a bent tube, to convey the gas to the receiver for the alkaline solutions. But before it is admitted into this, it passes into a small circular vessel, which is, according to the proportion of the apparatus, from twelve to eighteen inches diameter, and contains water in order to arrest any uncombined chlorine which may arise in the process; but since the water bath has been substituted for the sand bath, this seldom occurs. The gas is then admitted into a large receiver, charged with the alkaline, or calcareous solution, intended to receive and absorb the chlorine gas which comes from the still, and when sufficiently saturated it is drawn off by a brass cock fixed at about two inches from the bottom of the receiver. The receiver is of a square form, or that of an inverted cone, and is made of lead, where the capacity does not exceed 120 gallons, and of wood lined with lead, when the business is extensive. It is closely covered at top, and has a hole for introducing water into a receiver with a leaden plug. In some manufactories, two or three false bottoms made of lead, are laid on brackets of the same metal, fixed to the side of the receiver. These false bottoms are perforated, or made of spar work, in order to spread the chlorine through the water during distillation. The solution is constantly stirred, to promote the absorption of the gas, by an agitator, which, in large works, is driven by a power from a steam engine.—(Parkes. Ramsay.)

In recovering alkali from waste leys, it is found more economical to construct what are called stone boilers, than to employ vessels either of lead or iron. Stone boilers are large oblong chambers, whose lateral walls are about two feet high, and are built into the ground to prevent their giving way. The outside wall is well rammed with tempered clay puddle, to prevent leakage. An arch of

brick is thrown over between the walls, which is covered with mortar to retain the heat. Proper openings are at the same time left, by which to examine the state of the liquid; these are covered with a plate of iron. At one end of the chamber, a furnace of a sufficient capacity is built, having a breast work interposed between it and the liquid, over which the flame plays. At the other end of the chamber, a vent of a sufficient height is built to carry off the smoke. The fire being lighted, the flame plays along the surface of the liquid, which by this means is evaporated. Some of these stone boilers are so capacious as to contain 10,000 gallons. (Ramsay.)

When stone boilers are not used, common evaporating pans may be employed, and particularly in works of moderate extent. After the leys have been brought to a due consistence, the materials are removed to a small reverberatory furnace, and gently calcined. A common baker's oven is well adapted for this purpose, and is used, as we learn from Des Charmes, (p. 87,) in the manufactories of France. If the former is preferred, the process should, if possible, be continued night and day; or, at least, the fires should be raked up at night, and the passages of the chimneys carefully stopped. Furnaces which are thus wrought, will last seven times as long as those where it is not attended to; insomuch as the contraction of the materials, during the time of cooling, and their subsequent expansion, wear them rapidly out. (Parkes.)

To avoid the inconvenience and injury, arising from the escape of the noxious vapours of chlorine from the bleaching liquors, and to have the goods more equally exposed, than in the old mode of stratifying them above one another in large vessels, Mr. Rupp, of Manchester, contrived an apparatus extremely simple and ingenious. It consists of an oblong deal cistern, made water tight, with two perpendicular beams, made to turn round on their axles, and each furnished at the lower end with a plain pully of a large diameter. On one of these beams the cloth is rolled, after the pieces are slightly sewed together. This cistern is filled with the bleaching liquor, and the cloth is wound by means of a winch from one beam to another several times successively, so as to expose the whole of its surface equally to the fluid.

I shall conclude this part of my subject with a few practical notices, which are of importance to be attended to in conducting extensive bleaching manufactories.

1. When boilers are set in brick work, care should be taken not to make the fire places too large, for when the bars are not entirely covered with fuel, the cold air rushes in from the ash pit, between the uncovered bars, and counteracts the effects of the heat. Fire places should be no larger than is barely necessary for the fuel to produce the intended effect. They should be so constructed also, that the whole bottom of the boiler may be exposed to the action of the burning fuel, and that the whole of the flame and heated air, actually impinge upon the bottom, before they reach the sides to pass to the chimney; for the heat applied to the bottom will be infinitely more effective than that applied to the sides. To aid this, some large stills and

coppers are made with the bottom to project inwards, presenting a concave surface to the flame; some have, for the same purpose, a flue of 10 or 30 inches diameter running through them. (Parkes.)

2. As cast iron is so liable to break from its unequal expansion when submitted to heat, steam engine boilers are now usually made at a great expense, with plates of wrought iron rivetted together, which, in the end, prove to be cheaper, from their great durability. But much expense might be saved by making the *upper* part of cast iron, as that does not suffer from the action of fire. This might be attached by screws, and when the old bottom was worn out, it could be removed, and a new one put in its place. The vessel would then be as good as at first. (Parkes.)

3. In works where large and expensive iron boilers are used, sulphurous coals ought to be avoided if possible, as the sulphur rises during combustion, unites with the iron of the boiler, and forms a sulphuret of that metal, which wastes away as fast as it is formed, and soon renders the boiler totally useless. (Parkes.)

4. In places where peat is to be had, it is an economical fuel in manufactories. In some places of Scotland, we are told by Mr. Mushet, (Phil. Mag. VII. p. 44,) that it can easily be procured at a shilling per ton; and four tons of dried peat, as he distinctly shows, will make something more than one ton of peat char; a substance which produces a much stronger fire than coals, or coke. M. Sage informs us, that he found, by repeated experiments, that the turf char produces a heat nearly in the proportion of 3 to 1 of the best charcoal. But while we can say this much, we must not conceal, that it is not easy to make peat char, as it requires a peculiarity of management which can only be acquired by considerable experience.* (Parkes.)

5. A great deal of the sheet lead in the market is manufactured from old lead, and, consequently, contains solder and other impurities. Such lead ought carefully to be avoided in the construction of retorts and chambers; for a small portion of tin, or plumber's solder, will reduce the melting point of the metal, very considerably. Lead, for example, melts at 612° Fah. but with $\frac{1}{25}$ of tin, the melting point is at 558°; with $\frac{1}{14}$, at 555°; and with $\frac{1}{9}$, at 530°. Upon the same principles, Des Charmes cautions the manufacturer against joining any of his lead vessels by soldering, and recommends the fusing of the parts to be joined, as preferable; "for," says he, "in process of time the solder, though ever so strong, yet because it contains tin, is liable to excessive corrosion by chlorine, which is not found to attack lead, even when heated in any sensible degree." But if it cannot be managed without solder, the parts soldered must be defended by several coats of white lead, putty, rosin, or pitch mixed with bees' wax; any of which, experience proves to effectually answer the end. Lead is sometimes used for lining or securing parts of the kier which are thought to be in danger of leaking. Now, the

* Mr. Mushet has written several very instructive papers on this subject; see particularly Phil. Mag. vol. XXXII.

sulphur which is always contained more or less in potash, acts upon lead, forms a sulphuret, which being of a red colour, is liable to produce stains. (Parkes.)

6. I shall here mention a circumstance which, although it may seem trivial, is of some importance; namely, that in the roofs of bucking houses there should not, as there sometimes is, be any iron nails; for the steam from the boiling vessels will be condensed by the tiles; and the water thence arising, will wash off from the nails, the oxide which it contributes to form, and this, falling on the cloth, will produce stains, of whose origin the workmen may often be at a loss to discover the cause. No iron ought to be used in the roof of a bleaching house, nor any lime on the inner side of the walls. (Parkes.)

7. As some of the vessels in the bleaching process, may, when fuel is scarce, be heated by steam, and as in every case dryers and other parts of the apparatus are actually so heated, it will be useful to mention, that as charcoal is a very slow conductor of caloric, (in proportion to dry sand, as 3 to 2,) if all those vessels which are heated by steam, were made double, and the space between the outer, and the inner vessel, filled with ground charcoal, the heat would be so prevented from escaping, and any one particular temperature might be kept up for a great length of time, and make a material saving in fuel. (Parkes.)

8. Since the adoption of the dry oxymuriate of lime, the distilling apparatus is less used than formerly, as the bleachers buy this salt ready prepared. It is still used, however, in making oxymuriates of the alkalies. In this process, it is of the utmost importance to attend to careful luting; so much so, that Des Charmes affirms, (page 4,) "that the single obstacle of not knowing how to manage lutes, is quite sufficient to repel the efforts of the most zealous, in this kind of operation." To compose the fat lute of the chemists, take any quanty of good gray or blue clay, or fuller's earth, and dry it in thin cakes in an oven; then pound it finely and sift it; beat a sufficient quantity of this pulverised clay, with boiled linseed oil, in an iron or bell-metal mortar, till the whole mass is of a uniform colour; it will then be fit for use. That which has been made for a twelvemonth, if it have been kept in a covered earthen pot in a cellar, is better and more pliant, than when newly made. A large quantity ought always to be made beforehand, when the work is extensive. "I strongly insist," says Des Charmes, page 14, "on the perfection of this lute, because it is the soul of the distillation process."

FOR THE FRANKLIN JOURNAL.

Remarks on burning Anthracite in open fire places.

A paper was lately published in the Franklin Journal, on the use of stone coal, for the purposes of cookery, with the design of establishing the fact, that anthracite may be thus employed very advantageously, in a common fire place, and without the aid of a blower.

The experiments performed by Mr. Vaux, were made in April of the last year, and his full success has been reported by a Committee of the Franklin Institute.

I do not intend to detract in the least, from the credit due to Mr. Vaux, but think it right to state, that a grate, very similar to the one of which a plate with details has been given to the public, was in full operation, in my house, during the whole of last winter. It was more simple, however, than that of Mr. V.'s, and the one which I now have in use (put up in August last) is still less complicated. In place of the marble, or soap-stone top, I employ sheet iron; because it affords, by reason of its superior conducting power, a more extended surface for the operations of cookery. In lieu of an iron plate partition, for the purpose of making a small fire occasionally, I have a slip-grate, which, by being raised or lowered, lessens or augments the receptacle of coal, at pleasure.

But the *principle* of all this simplification was established, even anteriorly to the construction of my first grate, in September, 1825; and it was the observance of this principle, in an apparatus presently to be noticed, that led to the formation of the simple grate first used in my kitchen. Every one, almost, has seen, and many have purchased the summer furnaces for burning charcoal, which were originally of a circular form, but which were so modified in some instances, as to be of a semicircular shape in the upper two-thirds, the lower third remaining round. These have been denominated the *half moon furnaces*, and are always coated with sheet iron. Those who understand the management of Lehigh coal, can, with ease, kindle a good fire in the half moon furnace, by first igniting some charcoal, dry oak, or hickory, and then throwing on the stone coal in pieces of about the size of an egg. In a common fire place, or in the open air, a furnace of this kind may be used for burning Lehigh coal, unaided by any thing in the shape of a blower. During the whole of last summer, a furnace of the above description, with one of the round furnaces, served my family for all the purposes of domestic economy, in which fire was requisite; and stone coal was burnt in both, though to most advantage in the half moon furnace.

I have been well satisfied for more than a year, that Lehigh coal can be burnt with far less trouble than many persons imagine, and agree fully with Mr. Vaux, that it would be more generally preferred for cooking, if its advantages were better understood. A coal fire made in my grate (noticed in the former part of this statement) at ten o'clock, A. M. for the purpose of roasting, will burn well, undisturbed, until from six to eight in the evening, and then nearly a third of the coal will remain. What sort of wood fire can be kept up for so long a time, with so little trouble?*

THOS. D. MITCHELL.

Frankford, January 9th, 1826.

* My grate will hold, probably, a peck and a half.

Additional Remarks on Anthracite—By the Editor.

We were much gratified by the preceding communication from Mr. Mitchell; for although the fact has been long known to us, that anthracite might be burned without that great draft, and those other special preparations, which are generally deemed requisite, yet experience has taught us, that the publication of one or two experiments, however satisfactory, or however well authenticated they may be, will go but little way in removing strong prejudices. Mr. Vaux did not, in his communication, pretend to have made a new discovery, but only to have given a clear and striking exemplification of a fact, which, although known to some persons, was contrary to the general belief. The committee of the Franklin Institute, who reported upon the experiments of Mr. Vaux, were well aware of what had been previously done in this city, and elsewhere; and carefully avoided the giving a higher degree of credit to that gentleman than they believed to be merited by the industry with which he prosecuted, and the success with which he performed his experiments.

The Editor of the Miner's Journal had stated, nearly two years since, that "a chimney with the worst draft possible, will do for burning anthracite, perhaps better than one with a quick draft; for the fire burns more steadily, and of course the heat is more equal. If there be an aperture sufficiently large to carry off the small quantity of gas disengaged in the combustion of stone coal, it is all that is required."

"I have seen a fire, of our coal, burning delightfully in an open grate, in a large open kitchen fire place, within which half a dozen people might stand around the fire, and the chimney of which smoked to such a degree with a wood fire, that it was almost impossible to stay in the room." In the same paper, many other facts had been stated, proving the facility, and economy with which anthracite might be used, for almost every purpose for which fuel is necessary. These facts were *confirmed* by the experience of Mr. Vaux, and of others; and during the last summer, several of our citizens burned stone coal, in the open air; using the ordinary earthen furnaces. There are now a number of kitchens in which the whole of the cooking is satisfactorily performed with stone coal, in open grates. Mr. Thos. Hughs, Mr. John Moss, and several other gentlemen, have also perpetual ovens, which are heated by the fires in their grates, and which most completely answer the intended purpose. The grate in which Mr. Hughs burns the Lehigh coal, was made for the bituminous coal, and is of the kind which, in England, is called a kitchen range. The servants frequently place their kettles immediately upon the coals, with but little detriment to the fire; it is certainly better, however, to employ a trivet. Mr. Joseph Trueman has lately constructed a fire place in his kitchen, which promises to answer well. The grate is of the usual form; there is, upon that part of the hearth which is immediately under it, a grating which allows the ashes to fall into a receptacle in the cellar, whilst it admits an abundant draft of air to support the combustion; and which may be regulated by a valve. The jambs are built with brick, and in each there is a round hole left, in

the form of a chaffing dish, or furnace, with draft holes, and doors; both of which may be used at pleasure, as they are independent of the grate.

Such is the facility with which the stone coal is now managed in its combustion, that many persons are already at a loss to discover wherein consisted those difficulties which were encountered in the first attempts to use it; and we believe that the time will soon arrive, when our servants will, if required to use wood for cooking fires, object to it on account of the *difficulty* in managing it. In London, where bituminous coal is the only fuel, the whole corps of cooks would rise in open rebellion, were they required to substitute wood, in their operations; and we think that our stone coal is as much to be preferred to the bituminous kind, in all the operations of the kitchen, as our servants now think wood, is preferable to anthracite.

Novel as is the use of stone coal in the city of Philadelphia, it has been employed for upwards of fifty years, in some parts of the state. "Judge Gore, of Wilkesbarre, first used anthracite, or the Wilkesbarre coal, in his blacksmith-shop about the year 1770; and no other coal has been generally used in the Wyoming Valley, since that period. Judge Fell first introduced the *grate* for burning anthracite about eighteen years since. It was substantially the same as that now used for common domestic purposes, and has received very little improvement, other than ornament."* Were it necessary to exemplify the tardiness with which we learn, and profit by, the example set by our immediate neighbours, when our domestic habits are concerned, the facts above cited would be sufficient for the purpose.

A very injurious practice is generally pursued in the setting of our grates. This may be collected from some of the preceding remarks, but it is a point of so much importance as to merit a more particular notice. We allude to the strong draft which is given; as is evinced in the furnace-like roar of most of our fire places. The effect of this is to burn out the fuel with great rapidity, and to send a large portion of the heat up the chimney. Many of our workmen, having once adopted this plan, will pertinaciously adhere to it: and it will be necessary for those who are to pay for the coal, and to sit by the fires, to inform themselves on this subject, and to insist upon having the work performed in such a way as shall promote economy and comfort.

Many intelligent engineers have expressed an opinion, that anthracite would never be found to answer well in steam engine boilers. We are however informed, that at the Phœnix Nail Works, stone coal has been used for many months, and that it is preferred to every other kind of fuel; the fire place, we believe, was not constructed with a view to the employment of stone coal, but a little practice has served to prove that the difficulties anticipated in the use of it, were imaginary. It would indeed be strange, if a fuel so readily burned, and giving out an intense heat, should be incapable of having its heat combined with water, so as to convert it into steam.

* Miner's Journal.

Observations upon the Automaton Chess Player, now exhibiting in this city, by Mr. MÆLZEL, *and upon various Automata and Androides.—By the Editor.*

We have not the vanity to attempt offering any new speculations upon the subject of the *Androides*, usually denominated the *Automaton* Chess Player. Several publications have been devoted exclusively to the history of this figure, and an investigation of the probable mode in which it is made to operate; and many public journals, as well as most of the existing Encyclopedias, have noticed the subject. Wherever it has been exhibited, from the time of its first appearance, in the year 1769, to the present day, it has excited the ardent curiosity of all classes of society; and has been examined with a scrutinizing eye, by the Philosopher and the Mechanician; no novelty ought therefore to be expected from us, excepting, perhaps, in the manner of telling our thoughts.

The name of *Automaton*, which has been given to the chess player, is not in this case correctly applied; as an automaton has been defined to be *a self-moving machine, so constructed, that by means of internal springs and weights, it may move a considerable time, as if endowed with life.* Under this definition are included those results only, which are produced wholly by the operation of mechanical instruments: but were a figure exhibited, which should write an essay, or a poem, upon any subject which might be prescribed, every one would at once determine, that the motions of the hand *must* be under the guidance of intellectual agency; and the same conclusion applies, as necessarily, to a game of chess, as to any literary effort.

The chess player belongs properly to that class of figures which is denominated *androides*, a name derived from two Greek words, signifying *a man*, and *form*; it includes therefore all those figures which have been made to imitate the form, and actions of man, although a part, or the whole of the actions exhibited may be produced by a concealed intelligent agent. We will in a future number give a detailed account of some of the most ingenious contrivances, both of ancient and modern times, which belong to one or the other of the two classes of machines which we have named; at present our observations will be confined principally to the chess player.

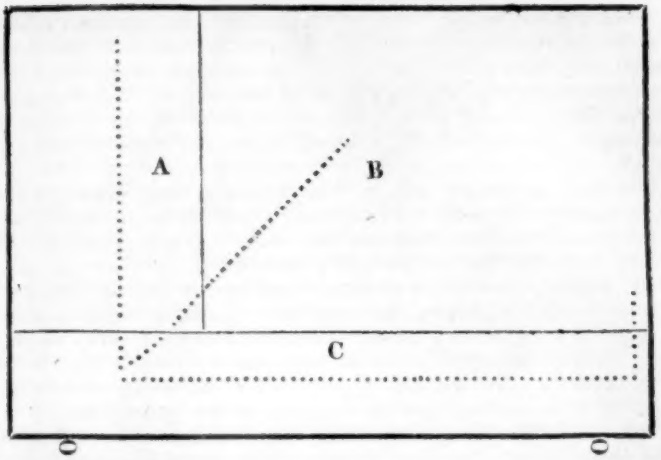
Baron Von Kempelen, (frequently written de Kempelen,) the inventor of this *androides*, was a native of Presburg, in the kingdom of Hungary, and was a member of the Aulic council of the German empire. He was a man of considerable talents, not only as a mechanician, but in general literature also, and published several dramatic and poetical compositions. He likewise published a very curious and interesting work, entitled "The Mechanism of the Voice, with a description of a speaking machine, illustrated by 27 plates." He succeeded more perfectly in imitating the human voice by means of machinery, than had any other person; unless we admit as evidence to the contrary, tales which bring with them evident marks of exaggeration, or of fiction. The fame acquired by the chess player has, however, served almost to eclipse the other works of this gentleman,

although the *real merit* of some of his productions was probably greater than that of this popular work. M. Von Kempelen's own observation with respect to it, was, "It is an amusing trifle, which possesses some merit on the score of its mechanism; but, that it appears so wonderful, is principally owing to the boldness of the idea, and to the happy choice of the means employed to render the *illusion* perfect."

The chess player was completed in the year 1769, and was exhibited in various parts of Germany; it was afterwards taken to Paris, and in the year 1783, was first shown in London. It was always accompanied, and exhibited by Kempelen himself. It has been already stated, that several publications have appeared, intending to show the manner in which the moves were, probably, directed; and the whole of these investigations seem necessarily to lead to the same conclusion; namely, that there *must* be some person concealed *within the instrument*, by whom the moves are made, through the intervention of machinery operating upon the principle of the pentagraph.

Von Kempelen had relinquished the exhibition of his figure for some years before his death: this has been generally attributed to some of the publications respecting it; but more particularly to a work which appeared in Dresden, written by Mr. Frederic Freyhere, a gentleman of known talents, whose book was accompanied by several coloured plates. Mr. Thomas Collinson, a man of science, saw Von Kempelen in the year 1790, soon after the publication of Freyhere's book, and found him quite silent upon the subject of the chess player; a circumstance which served to strengthen the impression, that the explanation which had been given, was the true one. In the 8th No. of the Edinburg Philosophical Journal, for April, 1821, there is a notice of a work which had just been published, entitled, "An attempt to analyse the automaton chess player, of M. De Kempelen." This notice is accompanied by a plate, intended to prove the possibility of concealing *a full grown man* within the chest, or commode, behind which the figure is seated. A copy of this plate, together with the explanations given, have been recently published in Boston, in a pamphlet which is for sale by Messrs. Carey and Lea, of this city. We would have procured a cut for the purpose of illustration, could it have been finished in time for the present number; but as the figure is now exhibiting in our city, we were unwilling to delay the present article, and all we can now do is to give a rough diagram, in order to render our description more plain than we could otherwise make it.

The following diagram represents the front of the commode, or table, behind which the figure is seated; it is about 3 feet 6 inches long, and 2 feet 6 inches in height; an ordinary sized man might therefore seat himself within it, in the direction of the perpendicular and horizontal dotted lines. The space A, is covered by a door, and there is a corresponding door at the back of the commode. The space B, has folding doors, and a door also at the back; C, is occupied by a drawer.



The exhibition commences by wheeling the commode, with the figure attached to it, from behind a curtain. The doors are all, at this time closed, and it is evident that the whole is completely isolated, as respects any external moving agent. Communication by means of strings or wires through the floor, or through the air, is altogether out of the question. The door at A, is first opened, the opposite door, at the back, is then opened, and a candle held behind, to enable the audience to see completely through this part of the commode. The lower part of this cavity, towards the front, contains a brass barrel, resembling that of an organ; this passes all across, and may be from three to four inches in diameter. There are also several brass wheels, and other appendages, which appear to occupy a large portion of the whole cavity, but which probably extend but a few inches within, leaving a clear space towards the back. The drawer is also partially opened, which, however, is supposed not to extend through more than half the depth of the commode, and to allow room behind it, for the legs and thighs of the occupant. When the two doors are open, the body may be bent forward into the cavity B, in the direction of the diagonal dotted line: the back door is then closed and locked, and the upright position of the body, may be resumed; for although the front door is still left open, the supposed space at the back is so much concealed by the wheels, &c., and so completely in shade, that a person within covered with sombre coloured garments, could not be seen. The front and back doors of the part B, may now be opened, and a light placed within them, without the slightest danger of betraying the secret. We deem it unnecessary to speculate upon the mode in which the individual within, may perceive the moves upon the board; several different conjectures have been made upon this point; we think that it presents no great difficulty, and that it might be accomplished in various ways.

We fully accord with the writer of the Boston pamphlet, in his remark, that the impression made on the mind, when the figure is seen for the first time, is, that it is impossible an intelligent agent should be concealed in the box. We were prepossessed with the idea, that this was really the case; still, the first actual exhibition had a tendency to weaken the impression, although a subsequent examination has restored, and almost confirmed this first opinion. The difficulties upon any other supposition, appear to be insuperable, and many of those fancies, which present themselves to the minds of those, who have only heard or read of the Automaton chess player, are completely dissipated when the exhibition is witnessed.

The objections which have been urged against this explanation, we do not think formidable. An intelligent youth, brought up to play the game of chess as a matter of business, would become an expert player, in the course of a year or two; and it is highly probable that the exhibiter may occasionally direct the moves, by preconcerted signs. It is said that when the thing was shown by the inventor, whoever could beat Kempelen, could beat the androides. A greater difficulty, in the estimation of many, is the danger that the concealed individual would cough or sneeze, during the time of exhibition; it will be found, however, that when in health, the inclination for these may be almost always suppressed; a concealed robber suffers, we apprehend, but little uneasiness from a fear of betraying himself in this way: the exhibition of the chess player is terminated in about an hour and a half, and should an absolute necessity exist, for removing it, before the expiration of this time, some token might easily be given, and a satisfactory excuse made to the audience. Numerous other exhibitions have depended upon a concealed accomplice, and in many instances, on one concealed for a longer period of time, than our supposed chess player is imprisoned at a *sitting*.

Were it indeed *impossible*, that any part of the table should be occupied by a concealed player, this impossibility might, without difficulty, be rendered perfectly evident to every visiter; but the united opinion of nearly all who have carefully investigated the subject, goes to prove that such a concealment is more than possible. Now, surely this is an opinion which every one must feel as calculated very materially to lessen the interest of the exhibition; yet it is one which has been long, and well known, to exist. If it *can* be destroyed, why is it allowed to continue? So far from its being either necessary or useful as a mere *ruse*, a removal of the suspicion which has existed so long, and so generally, would make the operation of the machine appear altogether inscrutable, and give to the automaton, as it were, a new creation. Why then, we again ask, is it allowed to continue, if it *can* be removed? That it *is* allowed, seems to us to amount almost to a demonstration that it is well founded.

The assertion so often repeated, that the automaton has never been beaten, or that it has been beaten but three times, once in Paris, once in London, and once in Boston, is well known to be incorrect. Expert chess players are not numerous, and the figure may therefore well get the game, in by far the greater number of in-

stances: among those who play publicly, there are, probably, but few who do justice to their own skill; the very nature of their situation almost forbids this.

The androides was beaten in a full game, by a lady in this city: and should it even be admitted, that *politeness* on the part of his Turkship, had something to do with this event, many other instances might be cited. Full games are rarely played, but in one held at three different sittings, and which lasted, altogether, five hours, an eminent player of Philadelphia made a drawn game. The Turk appeared in this case to be very hard pushed, as his pauses were long, one of which amounted to seven minutes and a half. Ends of games are those usually played—these serve fully to test the powers of the antagonists. and have repeatedly been gained by skilful players, opposing the androides. These remarks are merely intended to correct a prevailing error, and do not, in our estimation, detract, in the least, from the merit of the performance.

The exhibiter sometimes touches the table with his hand, during the progress of the game; at other times several moves are made without this being done; he is in the habit of putting his hands behind him, and moving his fingers in a way somewhat peculiar; he also works his feet upon the floor, in an unusual manner. These motions, we think, are intended to attract and divide the attention of the audience, and to excite their speculations; though they certainly may also serve as an envelop for real signals, should such be made.

Magnetism has often been spoken of as an agent which may probably be employed; it is mentioned in some of the books upon the subject; and as a proof that it was not used, it is stated that Von Kempelen allowed a strong magnet to be placed upon the table near to the figure. It is no uncommon thing when difficulties are encountered in producing certain motions, to ascribe them to magnetism. If those who speak thus would attempt to inform us *how* the effects might be produced by the aid of a magnet, they would generally manifest an entire ignorance upon the subject of magnetism, or find themselves involved in inextricable difficulty. This remark, we think, applies, in full force, to the subject in hand. The writer of the article in the Edinburg Journal, says, "If the impossibility of a chess player being concealed in the machine had been fully established, we should have had *no hesitation* in considering magnetism as the moving power." We think, however, that had he attempted to *apply* a magnet, so as to produce the effect, he would have found some cause for hesitation. But magnetism is sometimes as convenient as an *occult quality*.

As a work of art, the chess player possesses but little merit; the face is deficient in character and expression; its eyes roll in a manner altogether unnatural, and in making the moves, its hand and fingers exhibit a very faint resemblance to the action of a living being; the motions of the head are like those of the figures of Chinese mandarins. These, however, are minor considerations, and we are convinced that Mr. Maelzel, were he to construct a new machine, would, in these particulars, manifest much greater skill, than has been evinced by Von Kempelen in his chess player.

For the information of those who have not seen the exhibition, we ought to mention, that the chess board, upon which the moves are made by the figure, is firmly fixed upon the commode. A table, with another chess board, is placed in front; at this table the antagonist of the figure is seated, and the moves made by either, are repeated by Mr. Maelzel, on the opposite board. The figure plays with the left hand, which, when not in action, rests upon a cushion placed near to the board; the right hand rests upon the table, and if a false move be made, the figure notices it by striking this hand repeatedly upon the table, and shaking his head; after which, he returns the piece to its proper place, and makes his own move. A square black box, or board, is put upon the table, and near to the cushion; upon this board, or box, the figure deposits the pieces which he takes from his adversary. It is said, that Von Kempelen frequently consulted this box with great apparent care, and pretended that in it was contained the essential part of the secret, which he could communicate in a moment. No use is now made of this, excepting for the purpose above noticed. The exhibiter occasionally winds up some part of the machinery, but this is sometimes omitted, and is therefore unnecessary. When the arm of the figure is in motion, a noise is heard like that of the running down of a clock. To common observers, this gives the idea that the arm is moved by the machinery; but a little attention will render it more probable, that the wheels are moved by the arm. When the interior of the commode is shown, the drawer in the lower part of it is opened a few inches; some articles are taken out of it, and it is then closed. This drawer, we think, is made without a back, which prevents the distance to which it extends, being perceived by the spectator.

We are indebted to the present proprietor of the chess player, for some important information respecting its history. Mr. Maelzel, who was well acquainted with Von Kempelen, is undoubtedly a very ingenious, and, apparently, a candid man. The determination to make this machine, says Mr. Maelzel, originated in the surprise excited in the court of the Empress, Maria Theresa, by the performances of an eminent juggler. Von Kempelen had been invited to court to witness this exhibition, and after the performance, declared that he would produce something, which should surpass any thing they had then seen; and in due time he completed his chess player. Von Kempelen ceased to exhibit his machine soon after his tour in England. Mr. Maelzel states that his reason for this was, that being a man of fortune and station, he was unwilling to continue in this business. Another reason, however, was given by the late Mrs. Rivardi, to a gentleman well known in this city: she stated, that she was well acquainted with Von Kempelen, and with his family; that his daughter, a girl of 12 years of age, and an excellent chess player, was his coadjutor; and that her health declining, from the confinement to which she was subjected, it became necessary to stop the exhibition. We leave this relation to stand upon its own merits, only remarking, that the veracity of the gentleman, to whom the declaration was made, is not to be doubted.

Von Kempelen has been dead about twenty years: he had repeatedly offered his machine to Mr. Maelzel; but demanded 20,000 francs

for it, which was thought too much, and the bargain was consequently not made. About two years after the death of Kempelen, his son renewed the offer, and proposed to take one half the sum demanded by his father, to which Mr. Maelzel agreed, and the figure was removed from the garret, where it had lain for about twenty years. With the machine, the secret of its use was not given, as it had not been entrusted by Von Kempelen to his son; and the latter being a man of little talents, and having no fondness for mechanics, had not troubled himself upon the subject; but Mr. Maelzel, possessed of the machine, of course found no difficulty in discovering the mode of using it. He, however, thought it capable of considerable improvement, and determined to make several alterations, calculated to render its action, of more difficult explanation. This gentleman allowed about ten years to elapse before he commenced exhibiting the chess player, publicly; he had then made the alterations which he had projected, but had not however, added to it the speaking apparatus; the figure merely shaking its head twice when it checked the queen, and three times when it gave check to the king, as it had been made to do by Von Kempelen. Mr. Maelzel had already constructed and exhibited some speaking figures, and, whilst in London, some gentlemen suggested that it would be an improvement to make the Turk say *check*, and this alteration was consequently made in that city. On visiting Paris, the French work *echec* was substituted, and has been continued in this country.

The above account, will, we think, remove much of the difficulty which has been urged, as regards the number of persons to whom the secret, relating to the chess player, must have been entrusted, since the formation of the machine. It has been in the hands of but two persons, and has been off the stage for upwards of half the time which has elapsed since its first exhibition. Von Kempelen was, evidently, not very communicative upon the subject, as his son and heir, had not become his confidant. There are but few persons, however, who might not be trusted, were a considerable pecuniary interest, at stake.

Besides the chess player, Mr. Maelzel exhibits some other figures, which possess unusual merit. By moving the arm, one of them is made to pronounce the word *Mama*, with great distinctness, and the word *Papa*, is also tolerably well uttered. One of his slack-rope dancers, uses a French exclamation, the sound being elicited by the motion of the limbs. In these there is no confederacy, the sounds are mechanically produced, and are highly imitative: the attempts to accomplish such imitations have frequently baffled the skill of the most ingenious mechanicians. We had rather undertake to make the chess player, than one of the speaking figures, although the *labour* of the latter undertaking, would not be comparable with that of the former, so far as mere quantity of work is concerned. The evolutions of the figures upon the slack-rope, are admirably managed, very much surpassing, in merit, all that we have heretofore seen. The Automaton Trumpeter, a figure the size of life, performs a variety of airs, with the most perfect truth, and brilliant execution. The Editor has ex-

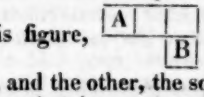
amined the mechanism of this figure, having been allowed so to do, by the liberality of the proprietor.

Mr. Maelzel has been for many years distinguished for his great mechanical skill. The Panharmonicon, which was formerly exhibited here, was made by him: he is likewise the inventor of the Metronome, an instrument by which the time in music is accurately measured; it is not unknown here, and is extensively used in Europe. He has also invented, an apparatus which is attached to a Piano Forte, by which any piece of music which is played on it, is at the same time correctly written out. His speaking figures are of his own make, and far excel the attempts of Von Kempelen, although the labours of the latter, were eminently successful.

The haste with which the foregoing remarks have been written, has prevented that arrangement which would have been observed under other circumstances; as an apology for this defect, we need only to state the fact, that the sheets were sent to the printer, in succession, as they were written; which was necessary, in order to their appearance in the present number of the journal.

The Knight's move in the Game of Chess.

BY THE EDITOR.

One part of the performance of the chess-player of Von Kempelen, consists in his covering, by the successive moves of a knight, every square upon the board, without touching either of them a second time. Many of our readers know the nature of this move, but for the sake of those who do not, we will observe, that it is made in a diagonal line, passing to the third square from the point of starting, in the manner represented in this figure, 

where one letter may represent the starting point, and the other, the square on to which the move is made; it will be seen that in every move, the colour of the square is changed. These moves may be very readily traced, by examining the numbers on the squares of the succeeding diagrams.

Several men of great celebrity have investigated the mode of doing this. Among them we find the names of Montmort, De Moivre, and De Mairan; each of whom has given a solution; but in each of their methods, some particular square is designated, from which the first move is to be made; the knight may not be placed upon any square upon the board, indifferently. The Automaton chess player, however, performs the circuit, commencing at any part of the board. The method by which this is accomplished was discovered by a gentleman who is not named, excepting as M. De W * * *, a captain in the Russian service. The following are the methods of De Moivre, and of M. De W * * *.

By De Moivre.

34	49	22	11	36	39	24	1
21	10	35	50	23	12	37	40
48	33	62	57	38	25	2	13
9	20	51	54	63	60	41	26
32	47	58	61	56	53	14	3
19	8	55	52	59	64	27	42
46	31	6	17	44	29	4	15
7	18	45	30	5	16	43	28

By M. De W * * *.

25	22	37	8	35	20	47	6
38	9	24	21	52	7	34	19
23	26	11	36	59	48	5	46
10	39	62	51	56	53	18	33
27	12	55	58	49	60	45	4
40	63	50	61	54	57	32	17
13	28	1	42	15	30	3	44
64	41	14	29	2	43	16	31

The first of these methods, may be more easily remembered than any other which has been given; as all the squares in the two outer rows, are first to be filled, excepting when a point is attained, which is not within reach of a blank on either of them, the third row must then be entered; but from this, we immediately repass to the two outer rows, until they are all filled. The same rule is observed as we approach the centre, never filling a square upon an inner, when a move can be made to an outer row. A little practice, will render this quite easy. A counter, or a piece of paper, should be placed upon each square as it is touched.

In the method of M. De W * * *, no general rule can be given for assisting the memory, and it consequently requires considerable practice; but when once attained, the moves are invariable, as they bear

some resemblance to a journey round a circle, which is still the same, at whatever point it is commenced. To accomplish this, it was necessary, that the last square reached, should be exactly a knight's move from the starting point, as may be seen on the squares 1 and 64, on the diagram.

A little consideration will render it evident, that we may designate any square we please, as No. 1, provided, the numbers occupying the other squares in the diagram, be changed in the same proportion. An example will make this clear. We will fix upon No. 6, on the right hand corner of the upper row; to reduce this to No. 1, we substract 5 from it, and we must proceed to do the same with every other number, excepting where such number is less than the subtrahend, in which case it must be added to 64, and the subtrahend taken from their sum; the first column will then be changed from 6, 19, 46, 33, 4, 17, 44, 31, to 1, 14, 41, 28, 63, 12, 39, 26, the 4 is here changed into 63, because 4+64−5=63. The whole board will then stand thus:

20	17	32	3	30	15	42	1
33	4	19	16	47	2	29	14
18	21	6	31	54	43	64	41
5	34	57	46	51	48	13	28
22	7	50	53	44	55	40	63
35	58	45	56	49	52	27	12
8	23	60	37	10	25	62	39
59	36	9	24	61	38	11	26

Although the numbers are here changed, the succession remains the same, and Nos. 1 and 64, are still a knight's move from each other. Another, and a more easy mode of changing this arrangement, is to begin at any number fixed upon, say for example, No. 30; from this pass regularly on to No. 64, and from that to No. 1, 2, 3, &c. up to 29, which will complete the circuit. The above rules are given to exemplify the *nature* of the arrangement, by which the end proposed, is attained.

Duck Shooting.

An article under the above title has been lately going the rounds of the Newspapers, the particular object of which is to make known the method pursued in decoying, and shooting, the canvas-back Duck, on the shores of the Susquehannah. We extract from Wilson's Or-

nithology, the account of *tolling in*, together with some other information respecting them, as given by him, written in his usual pleasing style, and containing at the same time, a more concise, and far more correct detail, than the account of "A Sportsman."

It has recently been announced, as a novelty, that canvas-backs have been shot on the Delaware, a few miles below this city; this *novelty* was published in the Ornithology twelve years ago, and had been then long known to naturalists and to sportsmen.

The Canvas-back Duck.

Extracted from WILSON'S ORNITHOLOGY, Vol. 8, p. 104.

"The canvas-back Duck arrives in the United States, from the north, about the middle of October; a few descend to the Hudson and Delaware, but the great body of these birds resort to the numerous rivers belonging to, and in the neighbourhood of the Chesapeake Bay; particularly the Susquehannah, the Patapsco, Potomac, and James' rivers, which appear to be their general winter rendezvous. Beyond this to the south, I can find no certain accounts of them. At the Susquehannah, they are called *Canvas-backs;* on the Potomac, *White-backs;* and on James' river, *Sheldrakes.* They are seldom found at a great distance up any of these rivers, or even in the salt-water bay; but in that particular part of tide-water where a certain grass-like plant grows, on the roots of which they feed. This plant, which is said to be a species of Valisineria, grows on fresh-water shoals of from seven to nine feet, (but never where these are occasionally dry,) in long, narrow, grass-like blades, of four or five feet in length; the root is white, and has some resemblance to small celery. This grass is, in many places, so thick that it is with difficulty a boat can be rowed through it, it so impedes the oars. The shores are lined with large quantities of it, torn up by the ducks, and drifted up by the winds, lying like hay, in wind-rows. Wherever this plant grows in abundance, the Canvas-backs may be expected, either to pay occasional visits, or to make it their regular residence during the winter. It occurs in some parts of the Hudson, in the Delaware, near Gloucester, a few miles below Philadelphia, and in most of the rivers that fall into the Chesapeake, to each of which particular places these ducks resort; while in waters unprovided with this nutritive plant, they are altogether unknown.

"On the first arrival of these birds in the Susquehannah, near Havre-de-Grace, they are generally lean; but such is the abundance of their favourite food, that towards the beginning of November, they are in pretty good order. They are excellent divers, and swim with great speed and agility. They sometimes assemble in such multitudes as to cover several acres of the river, and when they rise suddenly, produce a noise resembling thunder. They float about these shoals, diving and tearing up the grass by the roots, which is the only part of it they eat. They are extremely shy, and can rarely be approached, unless by stratagem. When wounded in the wing, they dive to such prodigious distances, and with such rapidity, continuing

it so perseveringly, and with such cunning and active vigour, as almost always to render the pursuit of them hopeless. From the great demand for these ducks, and the high price they uniformly bring in market, various modes are practised to get within gun-shot of them. The most successful way is said to be, decoying them to the shore by means of a dog, while the gunner lies closely concealed in a proper situation. The dog, if properly trained, plays backwards and forwards along the margin of the water; and the ducks, observing his manœuvres, enticed perhaps by curiosity, gradually approach the shore, until they are sometimes within twenty or thirty yards of the spot where the gunner lies concealed, and from which he rakes them, first on the water, and then as they rise. This method is called *tolling them in.* If the ducks seem difficult to decoy, any glaring object, such as a red handkerchief, is fixed round the dog's middle, or to his tail, and this rarely fails to attract them. Sometimes by moonlight the sportsman directs his skiff towards a flock, whose position he had previously ascertained, keeping within the projecting shadow of some wood, bank, or headland, and paddles along, so silently and imperceptibly, as often to approach within fifteen or twenty yards of a flock of many thousands, among whom he generally makes great slaughter.

"Many other stratagems are practised, and indeed every plan that the ingenuity of the experienced sportsman can suggest, to approach within gun-shot of these birds; but of all the modes pursued, none intimidates them so much as shooting them by night; and they soon abandon the place where they have been thus repeatedly shot at. During the day they are dispersed about; but towards evening collect in large flocks, and come into the mouths of creeks, where they often ride as at anchor, with their head under their wing, asleep, there being always centinels awake, ready to raise an alarm, on the least appearance of danger. Even when feeding, and diving in small parties, the whole never go down at one time, but some are still left above, on the look out.

"When the winter sets in severely, and the river is frozen, the Canvas-backs retreat to its confluence with the bay, occasionally frequenting air holes in the ice, which are sometimes made for the purpose, immediately above their favourite grass, to entice them within gun-shot of the hut, or bush, which is usually fixed at a proper distance, and where the gunner lies concealed, ready to take advantage of their distress. A Mr. Hill, who lives near James' river, at a place called Herring creek, informs me, that one severe winter, he and another person broke a hole in the ice, about twenty by forty feet, immediately over a shoal of grass, and took their stand on the shore in a hut of brush, each having three guns, well loaded with large shot. The ducks, which were flying up and down the river in great extremity, soon crowded to this place, so that the whole open space was not only covered with them, but vast numbers stood on the ice around it. They had three rounds, firing both at once, and picked up eighty-eight Canvas-backs, and might have collected more, had they been able to get to the extremity of the ice, after the wounded ones."

Ale and Porter Preserver.

In order to preserve ale or porter in good condition, for a considerable length of time, it is generally kept in bottles; and though the method of bottling does sufficiently well, yet Mr. Donovan remarks, it is subject to this inconvenience; that in cases where a small quantity, as one draft is wanted, all the rest of the ale in the bottle goes to waste, unless very small bottles be used, which would be expensive and inconvenient. Mr. Donovan concludes, that pressure is the secret cause of ale, &c. keeping so well in bottles; and, therefore, he has contrived an apparatus, by which the liquids may be constantly under pressure in casks, as well as in corked bottles. He has a vessel made in the form of a cask, of strong tin, strongly hooped; it stands on its end. At the upper end is a cock, soldered to a tube, which is immersed to within an inch of the bottom of the cask. At the same end is a condensing syringe, by means of which, air can be forced into the cask; and whenever this is done, it is obvious, that the liquor will have a tendency to escape through the tube, and out at the cock, with a force proportioned to the degree the air is compressed by the action of the syringe. If the cock be now turned, the ale rushes out with violence, forming, at the same time, a great quantity of froth, or what is called a creamy head. In this case it will be evident, that every time ale is drawn from the cask, the air it contains is not exposed to the atmosphere, the liquor is kept under pressure, no vent peg is necessary, and Mr. Donovan states, that the ale will come up sprightly and good, with a dense creamy head, to the last. In short, all the advantages of bottling will be obtained, without the disadvantage of sacrificing a whole bottle, when no more than a small quantity is required.

Remarks by the Editor.—In the year 1810, Dr. Robert Hare invented a cask for the purpose of preserving fermented liquors from the deteriorating effects of atmospheric air; and to cause them to rise by the elasticity of the fixed air, which is disengaged from them, and which, in ordinary casks, finds its way, gradually, through the pores of the wood. These casks were made of oak, and, in some instances, headed with cast iron; they were strongly hooped, were small in diameter, and the wood was saturated with oil and wax, so as to fill the pores, and render the barrels completely impervious to air. They were furnished with a tube, similar to that above described, which is analogous to those used in mineral water cisterns. These barrels were capable of sustaining an immense pressure; this is not the case with vessels made of tin, which must, in warm weather particularly, be liable to burst by the elasticity of the disengaged air.

Dr. Hare also used the forcing syringe, knowing that the quantity of atmospheric air to be forced in, would be insufficient to produce acidity. There is, however, a strong objection to the use of such vessels, because, simple as they appear to some individuals, most persons find a difficulty in managing them, and prefer the ordinary and more simple mode of procedure.

Model of a Steam Carriage.

The Reading-room of the Mechanics' Institute, in Hull, England, was crowded, in November last, to witness the exhibition of a model of a steam carriage to run on common roads. This machine weighs eighty-two ounces, is eleven inches in length, has three wheels, and is guided by a lever in front. The boiler and engine are placed in the hinder part of the carriage; the steam cylinder is half an inch bore; and the stroke of the piston is seven-eighths of an inch. The eighth part of a pint of water being put into the boiler, (which is heated by a tallow lamp,) causes it to go for the space of half an hour. It will turn in a circle, the diameter of which is only twice the length of the carriage, and the inner wheel will form the centre of its motion. It is capable of being backed in a moment with the greatest ease, and when allowed to run in a straight direction, at its greatest speed, will proceed at the rate of upwards of five miles per hour. The youthful inventor is a clerk, and the machine is the production of his leisure hours.

Remarks by the Editor.—Scarcely a week passes without some public notice of a *New Steam Engine*, which is to produce a mighty revolution in the structure, and the use, of that instrument; this notice goes the rounds in the newspapers, and, in the greater number of instances, we hear no more of the invention. But few of those persons who propose improvements in the Steam Engine, are intimately acquainted with the principles concerned in its action, and its application; and a still smaller number, know the history of what has been heretofore attempted with regard to it. The consequence is, that the first imperfect machines are reinvented, and brought forth as novelties and improvements. In the above instance, we think that the young gentleman who made the model in question, has employed his leisure hours in a way which entitles him to much praise; and have no doubt that he has manifested great ingenuity and skill; but we apprehend that the running of his model upon the table, or floor, will not serve to prove that a large carriage, made upon the same principle, would "run, on common roads." We are sorry when we see young men of evident talents, making a public parade upon such a subject, as we believe such parade is likely to be the precursor of disappointment and mortification.

Description of the Chain Bridge over the Straits of Menai, North Wales.

The following description of the stupendous chain bridge in North Wales, is furnished by a friend, who has lately received it in a letter from a gentleman now travelling in England.

"This stupendous structure, this miracle of art, this modern colossus, has alike excited the wonder of the vulgar, and called forth the admiration of the learned and scientific; and bids fair to stand for ages an amazing

monument of British ingenuity—nor could I but reflect, that when death shall deprive our country of the man whose consummate skill projected the work, he will have no need of any monument, for it is already erected over the straits of the Manai:—but I must apologise for this digression, as eulogy is but poor description. The morning being fine, I resolved to see the "CHAIN BRIDGE" before breakfast, and accordingly set out. On my way thither, I overtook a very intelligent man, whom I found, after a little conversation, to be one of the under engineers, and to whom I owe my information, as to the principles and admeasurements of it.

"On account of the hilly nature of the ground on each side of the straits, piers of granite are built on each side, which make the road level with the country. These piers, are built on arches of 52 feet span; from high water mark, to the spring of each arch, is 65 feet, and lead to the grand pillars from which the chains are suspended in massive, yet graceful festoons. These pillars tower 152 feet above high water mark: through them are gate ways which lead to the carriage roads, 9 feet wide, 15 high: there are two carriage roads, each 12 feet wide, and a foot path between them 3 feet wide.

"The chains, 16 in number, are 1714 feet in length, formed of links composed of five bars of wrought iron, 10 feet long, 3 inches deep, and ¼ an inch thick; these five bars are put side by side, and riveted by bolts; forming an almost solid bar, of 10 feet long, 3 inches deep, and 2½ inches thick; of these links the chains are formed; four of which chains, form one great chain; and these four, are so suspended, that the middle of the upper links, fall on the joints of those underneath. This is a description of such links as hang from pillar to pillar, a distance of 553 feet; those from the pillars to the fastenings, are rather shorter, and thicker: I traced them to the rocks where they are fastened, and was truly surprised at the amazing strength and apparent security of the whole, and could not help questioning whether Jove's

"——— everlasting chain,
Whose strong embrace holds heaven, earth and main,

were half so well secured.

"In the saddles over which the chains pass on the tops of the pillars, rollers are placed, to prevent any accident happening from the contraction or extension of the iron work by heat or cold, as also from the heat or cold affecting either side, unequally.

"The vertical rods suspended from the chains are of iron, one inch square, and serve to support the sleepers on which the flooring of the road-way is laid, these rods are five feet asunder: a neat railing of about five feet high, runs along the whole line of the bridge."—*N. Y. Com. Adv.*

Cast Metal Pianos.

Every day the use of cast iron is becoming more general; bridges and steam-boats are made of it; in England it is used for roads; and at

Liverpool, churches are built of it. Here, in Paris, we have lately got Pianos, the frame-work of which is formed of cast iron. These instruments have been brought to such perfection, by MM. Pleyel and Company, that not only do they rival, but, in many particulars, surpass the best English instruments. The solidity of the frame-work is so great, that they seldom get out of tune, and the sound-board relieved from those enormous pieces of wood with which it was formerly cumbered, in order to resist the strain, possesses much more elasticity, and seconds the vibration of the strings, much better. The tone of these instruments is wonderful, both in power and mellowness; and the mechanism is so perfect, that it admits of the most delicate, as well as of the strongest touch. Indeed, we have no doubt that when they are known, they will put an end to the importation of foreign Pianos. MM. Pleyel and Co. have also just obtained a patent for square Pianos, with single strings.—*French paper.*

Chinese method of making Sheet-lead.—The sheet-lead which comes from China, is manufactured in a way not generally known in this country. The operation is conducted by two men. One is seated on the floor, with a large flat stone before him, and with a moveable flat stone-stand at his side. His fellow workman stands beside him with a crucible filled with melted lead, and having poured a certain quantity on the stone, the other lifts the moveable stone, and dashing it on the fluid lead, presses it out into a flat and thin plate, which he instantly removes from the stone. A second quantity of lead is poured in a similar manner, and a similar plate formed; the process being carried on with singular rapidity. The rough edges of the plates are then cut off, and they are soldered together for use.

Raining Trees.—In the ancient histories of travellers in America, and also by Thévet, in his Cosmographia, mention is made of a tree which attracted the clouds from the heavens, and converted them into rain in the dry deserts. These relations have been considered as fables. There has been lately found in Brazil, a tree, the young branches of which drop water, which falls almost like a shower. This tree, to which Leander has given the name of *Cubea Pluviosa*, is transferred by M. Decandolle to the genus *Cæsalpina.*

King of Portugal's Diamond.—From the following statement of the weight of the largest diamonds known in Europe, it will be seen that the King of Portugal possesses the very largest. The diamond of the Emperor of Russia weighs 106 carats;* that of the King of France, 136; that of the Grand Duke of Tuscany, 139; that of the Great Mogul, 279; that of the King of Persia, 493; that of the King of Portugal, 1610 carats. The value of this last is estimated, by the Portuguese jewellers, at 200,000,000 of pounds sterling; by the French jewellers, at 1200,000,000 of French livres; and by the English and Dutch jewellers, at 55,787,300 pounds sterling.—*Hamburgh paper.*

* A carat is about four grains.

Spinning Flax.—MUNICH.—One of the greatest difficulties in mechanics, and which was but imperfectly overcome, though great rewards were offered both by England and France, was to contrive a means of spinning flax like cotton. This problem has now been happily solved by M. Hofer, of Meram, in the Tyrol, who, having matured his ideas, came to Munich, and employed an able mechanician, M. Ertl, to make a machine according to his directions. In this he has fully succeeded, and M. Hofer has obtained a patent from his majesty, the king of Bavaria, and will solicit patents also from Austria and Prussia.

Large Steam Vessel.—One of the largest Steam vessels ever built in this country, has recently arrived in the Thames. It is intended to convey passengers from London to Edinburg, and to all the intervening ports at which she can conveniently touch. She is called "The United Kingdom," and has just finished an experimental trip round the north of Scotland, highly to the satisfaction of her owners, and a large party on board. She was built by Steel & Co. of Greenock, and Napier & Co. Engineers, of Glasgow. She is 1065 tons burthen, her length 175 feet, her breadth 45 feet—she has two Engines of 100 horse power each—and the number of beds for passengers 150. On her first trip, she ran the first 240 miles, with the wind unfavourable all the way, in 21 hours, and did 750 miles in 73 hours, including a number of stoppages. It is said that her Engines produce little or no noise, and that her interior embellishments are of a superb description.—*London paper.*

Gas Works.—A discovery of great importance has lately been made by Mr. Archibald Cook, manager of the Paisley Gas Works. The gas tar, which is of little value and troublesome to get quit of, Mr. Cook has applied as a substitute for coal, in heating the retorts, in the production of gas. The practical result of his experiment has been completely successful. The ingenious method by which this operation is conducted, is entirely new, and must produce the Paisley gas company, an annual saving of several hundred pounds, and to other establishments a greater, in proportion to their extent. Mr. C. has deservedly gained much credit by his exertions, in producing such improvements; and there is no doubt but that this discovery will soon be universally known, adopted, and duly appreciated.

Preservation of Apples.---The following observations contained in a letter from Noah Webster, Esq. have been published in the Massachusetts Agricultural Repository.

"It is the practice with some persons to pick apples in October, and first spread them on the floor of an upper room. This practice is said to render apples more durable by drying them. But I can affirm this to be a mistake. Apples after remaining as long on the trees as safety from the frost will admit, should be taken directly

from the trees, to close casks, and kept as dry as possible. If suffered to lie on the floor for weeks, they wither and lose their flavour, without acquiring any additional durability. The best mode of preserving apples for spring use, I have found to be, the putting them into dry sand as soon as picked. For this purpose I dry sand in the heat of the summer; and late in October, put down the apples in layers, with a covering of sand upon each layer. The singular advantages of this mode of treatment are these: 1st, the sand keeps the apples from the air, which is essential to their preservation. 2d, The sand checks the evaporation from the apples, and thus preserves their full flavour—at the same time any moisture yielded by the apples, (and some there will be) is absorbed by the sand; so that apples are kept dry, and all mustiness is prevented. My pippins, in May and June, are as fresh as when first picked; even the ends of the stem look as if just separated from the twig."

French Patents, 1826.

J. G. Ulrich, London, for his importation and improvements in the construction of chronometers. 5th May—15 years.

J. Despiau, Senr., Bordeaux, Department Gironde, for his invention of a machine to batt, open, and clean wool. 12th May—10 years.

J. M. Hanchett, and H. G. Smith, Paris, for improvements and additions to their patent of importation for an apparatus to compress gas. 1st July, 1824—15 years.

De Lamortiziere, Paris, for improvements and additions to his patent for a machine to drive boats up rivers. 17th March—10 years.

A. J. P. Thilorier, Paris, for his invention of a lamp he calls "hydrostatic." 12th May—5 years.

F. Rouard, Paris, for improvements and additions to his patent of invention for manufacturing of tiles to cover houses. 3d March—5 years.

P. N. Tastemain, Swonches, Department Eure et Loir, for his invention of a machine to cut the corn in the field. 12th May—15 years.

T. H. Pape, Paris, for his improvements in the construction of Piano-fortes. 12th May—10 years.

Madame Regnauld, Paris, for her invention of a "pectoral paste." 19th May—15 years.

Norbert Rillieux, Paris, for his invention to obtain hydro-carbonic gas, at different degrees of pressure. 19th May—10 years.

J. B. D. Perot, Paris, for his invention of a process and means to mark the points at card playing, or other games. 19th May—5 years.

C. Guigo, Lyons, Department Rhone, for his invention of a machine to weave, &c. 19th May—10 years.

P. M. Daulle, and L. J. Cordier, Paris, for their importation of a machine to prepare wool, silk, &c. 19th May—5 years.

P. Tremblot Lacroix, Paris, for his invention of a machine he calls "compositor typographic." 2d June—5 years.

J. J. Burle, Paris, for his invention of a composition of platine. 2d June—5 years.

H. Langlois, Paris, for his invention of a cock applicable to machines containing gas. 2d June—5 years.

P. Tespar, Paris, for his invention and improvement of an apparatus he calls "Fumivore vaporator et condenzator." 2d June—10 years.

Fehr, et Vic-dezsos, Department Arriege, for his invention of vessels or pots to manufacture mineral, vegetable, or animal coal. 2d June—10 years.

G. W. Walker, Lorint, for his invention of a loco-motive carriage. 2d June—10 years.

A. Christofle, Junr., Paris, for his importation and improvement in the manufacturing of buttons from tortoise-shell, bone, &c. 2d June —5 years.

J. Rocher, Paris, for his invention of a wheel to regulate the emission of portable gas. 2d June—15 years.

Maillard-Durneite, Paris, for his invention of a cylindrical distilling apparatus. 2d June—10 years.

P. Raviers, Paris, for his invention and improvements of a composition he calls "ladies' coffee." 2d June—10 years.

J. D. Fisher, Paris, for his invention, importation, and improvement of a set of machinery, to card, prepare, and spin wool, and other fibrous materials. 9th June—15 years.

M. J. A. Comoy, Nevers, Department Nievre, for his invention of a new wine press. 9th June—5 years.

P. E. Kinkelin, Paris, for his invention of a process to anchor boats on navigable rivers. 9th June—5 years.

LIST OF PATENTS IN ENGLAND,

Which have passed the Great Seal since August 22d, 1826.

To John Charles Schwieso, musical instrument maker, for his invention of improvements on certain stringed musical instruments—Sealed 22d August.

To Timothy Burstall, of Leith, Scotland, and John Hill, of Bath, engineers, for their invention of certain improvements in the machinery for propelling locomotive carriages—22d August.

To James Yandall, private person, for improvements on apparatus for cooling and heating fluids—24th August.

To Francis Halliday, Esq. for his invention of certain improvements in raising or forcing water—24th August.

To William Downe, plumber and brass-founder, for his invention of certain improvements on water closets—25th August.

To Robert Busk, and William King Westly, flax-spinners, for their invention of certain improvements in machinery for flecking, or dressing, and for breaking, scutching, or cleansing hemp, flax, or other fibrous substances—29th August.

To William Day, trunk and camp equipage maker, for his invention of certain improvements on bedsteads, which improvements are also applicable to other purposes—31st August.

To Thomas Robinson Williams, Gent. for his having invented or discovered a machine for separating burs or other substances, from wool, hair, or fur—18th September.

The same, for an improved method of manufacturing hats and caps, with the assistance of machinery; 18th September.

To John Riste, lace manufacturer, for his invention of certain improvements in machinery for making net commonly called bobbin or twist net—4th October.

To Francis Halliday, Esq. for his invention of certain improvements on apparatus used in drawing boots on, and off—4th October.

To Theodore Jones, accountant, for his having found out and invented improvements on wheels for Carriages—11th October.

To William Mills, gentleman, for his invention of improvements in fire-arms—18th October.

To William Church, Esq. for his invention of certain improvements in printing—18th October.

To Samuel Pratt, camp equipage manufacturer, in consequence of a communication from a Foreigner, resident abroad, and discoveries by himself, for an invention of certain improvements on beds, bedsteads, couches, seats, and other articles of furniture—18th October.

To William Busk, Esq. for his invention of certain improvements in propelling boats and ships, or other vessels, or floating bodies—18th October.

To James Viney, Colonel in our Royal Artillery, and George Pocock, gentleman, for their invention of certain improvements in the construction of cars and other carriages, and the application of a power, hitherto unused for that purpose, to draw the same; which power is also applicable to the drawing of ships, and other vessels, for raising weights, and for other useful purposes—18th October.

NOTICES.

The "Essays on Mathematics," commenced in the last number, will be either discontinued or rewritten. Judging from the first essay, the Editor had determined upon the insertion of the series, but a further examination has proved that they are too defective, both in style and arrangement, for the pages of this Journal.

The inquiries made by an Alabama correspondent, shall receive due attention. The Editor is aware of the importance of the subject; and has taken measures to furnish full information, respecting it.

The length of several of the articles in the present number, has prevented that *variety*, in the subjects treated, which will generally mark our pages. The practical mechanic, need not fear that we will either forget, or neglect his interest, or his gratification.